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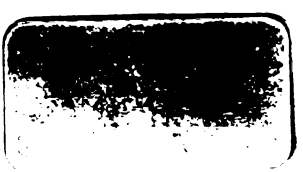

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TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY.

VOLUME XII.

BODLEIANA

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TRANSACTIONS AND PROCEEDINGS.

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PROCEEDINGS AND TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

SESSION XXXVIII.

13th November 1873.—JAMES M'NAB, Esq., President, in the Chair.

The following gentlemen were elected Resident Fellows:—

GEORGE H. POTTS.
THOMAS HUME, M.B. and C.M.

The President delivered the following address:—

Before relinquishing the Presidentship, to which I was elected through your kindness last year, I shall endeavour to fulfil the duties of the retiring Chairman, by offering some practical remarks on culture in relation to climate.

One of the chief topics which has occupied my attention for many years is the difference observed in open-air vegetation previous to the years 1837–38, as compared with the present time. I trust that Mr Buchan will supply from his store of meteorological treasures the facts and figures necessary to render this paper of greater importance than it can be in its present shape. Many of the shrubby plants at one time familiar to the oldest members of the Society in this part of Scotland, are now rarely to be met with in the open air, and certainly not in a state of perfection. Whether this is owing to a deterioration of our ordinary summer climate, o

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to the non-ripening of the wood from the want of sun heat, it is not easy to say; but I shall endeavour to prove that a change has taken place during the last forty or fifty years. Three severe winters, viz., 1837–38, 1841–42, and 1860–61, destroyed a large number of fine plants. Of those killed, many were replaced; some succeeded well, while others have never shown their former vigour. To illustrate my remarks, a few examples will suffice.

Trees and Shrubs.—For a considerable time, both before and after the year 1835, the *Hydrangea* used to be grown abundantly in gardens and pleasure-grounds near Edinburgh, producing in many cases twenty to forty heads of blooms on each plant. The wood ripened by the sun was usually protected during winter with mats or spruce fir branches. The sweet-scented verbena (*Aloysia citriodora*) also formed large round clumps, and flowered freely every year; now this plant, like the hydrangea, only lives in the open air in sheltered places near the sea, and flowers very rarely. Numerous varieties of the rock rose, or *Gum cistus*, were extensively cultivated in our gardens about forty years ago. The gorgeous bloom and varied colours of their flowers were always a source of interest. Now many of the varieties are lost to the country, and few are seen in any garden, although many of them ought to grow well in the west of Scotland.

About the same period, the common myrtle was seen in a vigorous condition, both on walls and as standards. Wall-trained specimens used to flower and fruit abundantly, but now flowers and fruit are rarely to be met with. During the winter of 1860–61 a large myrtle was killed which had flowered regularly on the garden wall at Leuchie House, North Berwick. A section of the stem proved that this plant was a century old.

Along with these suffruticose plants may be enumerated *Punica Granatum*, *Benthamia fragifera*, *Ribes speciosum*, *Maclura aurantiaca*, *Cupressus sempervirens*, *Aristotelia Macqui*, *Photinia serrulata*, *Eriobotrya japonica*, *Azalea indica alba*, and *Ligustrum lucidum*. The *Ligustrum*, occasionally seen in shrubberies, shows a more spindly habit than it did. *Mespilus Pyracantha* used to grow freely, and flower and fruit abundantly on our walls, but is

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rarely now seen in perfection. The *Catalpa* tree which used to attain a height of 18 or 20 feet, seems fast dwindling away. The fuchsia, particularly *F. coccinea*, *F. gracilis*, *F. tenella*, and *F. discolor*, with the hybrid variety called *F. Riccartoni*, used to stand our winters well, except the two last-named, which on this side of the island were frequently cut to the ground, but never killed; the others are now scarcely to be met with.

The almond tree used to produce flowers nearly as fine as those in the neighbourhood of London; our climate now does not seem to be sufficiently warm to allow it to ripen its wood so as to enable it to produce flower-buds, and most plants now seen in bloom are imported from England with the flower-buds already formed.

Acacia dealbata or *affinis*, a New Holland tree, used to luxuriate in the open borders; I have seen it growing in the Botanic and Experimental Gardens, averaging about 26 feet in height, with stems 20 inches in circumference at the base, and frequently producing flowers. A specimen grew near the rockwork in the garden of the late Dr Neill at Canonmills. It was 12 feet high, with a stem 10 inches in circumference at the base. Many others were seen in various gardens in the East of Scotland. *Eucalyptus pulverulenta*, another New Holland tree, used to be an ornament on our lawns, but, like the acacia, it has now ceased to exist as a standard. Specimens are occasionally seen on walls, but with the greatest care they are with difficulty kept alive for any time.

How different it is in the west coast of Scotland, where these plants are often seen growing luxuriantly. Every one who has travelled in Argyleshire, particularly round the more sheltered parts of the coast, must have been surprised at the vigorous state of the fuchsias, many of great size and age, and seeding abundantly. Seedlings are often found in situations which make it evident that the seeds must have been scattered by birds, and in another generation the fuchsia will probably be set down as a naturalised plant. In the west we also see species of *Hydrangea*, *Arbutus*, *Escallonia*, particularly *E. macrantha*, with many other half-hardy plants, growing strong and flowering well.

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Among suffruticose plants, *Melianthus major*, *Euphorbia aleppica*, and *Erythrina laurifolia*, used to grow freely in the Edinburgh gardens, and in several gardens of East Lothian. They are now rarely seen except in very sheltered situations near the sea, and the vigour of former times seems totally gone.

Our exotic walls, previous to 1837–38, used to be profusely covered with the flowers of *Magnolia conspicua* and *grandiflora*, *Passiflora cærulea*, *Indigofera australis*, and *Bignonia radicans*. Although these plants still live, they do not flower as formerly. *Passiflora cærulea* occasionally produces a shoot sufficiently strong to bear a few flowers, but its beautiful golden fruit is not now met with. During my frequent visits to Dublin about the year 1832, it was a treat to see *Passiflora cærulea* growing on many of the houses with a southern exposure. The plants trained on the houses had branches 30 or 40 feet in length, and were covered in autumn with golden fruit—a sight which I have not seen even in Dublin for many years.

About forty years ago the strawberry tree (*Arbutus Unedo*) used to be one of the greatest ornaments of our shrubberies, particularly during winter, being then literally covered with beautiful red berries. During the year 1838, 300 plants, exclusive of hedges, were killed in the Botanic and Experimental Gardens, many averaging from 8 to 30 feet in the circumference of the branches. The largest specimen destroyed was 60 feet in circumference and 18 feet high. A large *Arbutus Andrachne*, 18 feet high, and the circumference of its branches 70 feet, was likewise killed. The two latter shrubs were removed from the Botanic Garden at Leith Walk in 1822, when of large size, and planted in a border in front of a south wall. At the time of their death they could not have been less than eighty years old, showing that they had enjoyed a climate suitable for their growth during many years.

About the time alluded to, *Kalmia latifolia* also used to flower profusely in the open air, the plants being from 4 to 8 feet in circumference. For the last thirty years this Kalmia has rarely been seen in bloom, and then only a

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truss here and there after a warm summer. To see the Kalmia in perfection now we must import it from the south, with flower-buds already formed. At present the *Kalmia latifolia* is one of our handsomest evergreen shrubs, whether growing in black peat soil or leaf-mould and sand, and when free from the roots of deciduous trees, often forming dense hemispherical plants, 4 feet in height, and 20 to 30 feet in circumference.

Few shrubby plants used to grow better and flower more freely than *Erica arborea* and *E. australis*. They formed large bushes both on walls and as standards. Although the former species now thrives and occasionally flowers, it is frequently cut down, whilst *Erica australis* has almost disappeared.

The Larch.—How is it that, although an enormous quantity of seeds of larch is annually imported, few of the trees seem to have the vigour of those originally introduced at Dunkeld and Monzie about 135 years ago? I do not wonder at debility existing in some of our larch forests planted with seedlings raised from home seed, as it is not unfrequently taken from trees covered with cones, and often diseased. This diseased state often causes the trees to cone freely at an early period of their growth. But when we see trees raised from foreign seeds diseased before assuming proper tree-growth, I am inclined to think that our Scotch climate is not what it was when the larch was first introduced.

A substitute for the Larch has long been talked of, but nothing definite has yet been adopted. I may remark that I should like to see the Wellingtonia planted as a nurse tree, as has long been done with the larch. Independently of seeds, which can be got in large quantities, no tree of recent introduction can be propagated faster, as it grows readily from cuttings. A group of Wellingtonias, twenty-six in number, now in the Botanic Garden, were struck from cuttings fifteen or sixteen years ago; they are all handsome and vigorous, ranging from 9 to 14 feet in height. From what I know of these trees I feel satisfied that if planted amongst other trees they will do better than when planted singly on grass lawns, as we are accustomed to see them. It is said that the wood is soft in its native

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country, on account of its free-growing nature; but in a climate like this it grows more slowly, and the wood in consequence may be fitted for many useful purposes.

The Yew.—It may be supposed by some that the yew tree is not so hardy as it once was, because few are seen coming on to take the place of the old trees now existing in various localities. This, however, is not owing to want of hardiness, but is due to the want of stem-pruning at an early period, so as to induce a tree growth. Many yews planted during the last thirty or forty years in gardens and shrubberies have been allowed to grow as bushes, instead of being stem-pruned at an early stage, to encourage an upward growth. We see some of our finest and oldest yew trees in churchyards, where, at an early period of their growth they had been stem-pruned, to prevent the low branches spreading over much valuable ground. If pruning had been adopted in gardens and shrubberies as in the churchyards, we should have had many more of these beautiful trees scattered over the country.

I feel convinced that the stem-pruning recommended for the yew will be equally beneficial to many other evergreens, as the cedar of Lebanon. Many of these planted during the last forty or fifty years are seen as large rounded evergreens instead of trees, which would have been the case if stem-pruning had been early done. The same remarks apply to the beautiful Atlantic cedar, and to *Cupressus Lawsoniana*. Many unpruned specimens of the latter will in time become like large unsightly specimens of Arbor-vitæ, laid open with every fall of snow, and spreading in all directions, which never happens to stem-pruned specimens. I feel certain that the stem-pruning of trees just named, besides being beneficial in encouraging a free growth, has also a tendency to render them hardy, from the fact that the bark on the pruned stems is freely exposed and hardened, instead of being rendered tender by being closely surrounded with branches while in a shrub-growing condition. Numerous examples of pruned and unpruned specimens of the above species are to be seen in the Botanic Garden. The upward growth of the pruned stem is well marked as contrasted with the unpruned one, and I feel satisfied that during a severe winter the stem-pruned

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specimens will stand better than those which are unpruned.

At the period of which I speak we had few periodicals recording the state and progress of horticulture, with which we can compare the statistics of vegetation of recent years. I therefore detail what I have myself seen, but I might give many other examples to prove a change of climate during the last fifty years. It must be evident to all that we have not the amount of summer heat that we experienced in former times, nor the regular seasons in winter, when frost at Christmas was as certain to come as Christmas itself, and often lasted for weeks. Of late years, with few exceptions, we have often as mild weather at Christmas as in spring or autumn. The causes of these changes in our climate I am unable to explain, but changes have taken place, as evidenced by the almost total disappearance in the open air of the trees alluded to, notwithstanding all the care and trouble taken to introduce them again into open-air cultivation.

I may here state a circumstance in reference to *Tamarix gallica*, which seems to be in opposition to the remarks I have made. This plant abounds in the villa gardens on the south shores of England, its lively green colour being the admiration of all tourists, but it is rarely seen in the gardens or nurseries of Scotland. In a garden facing the sea at the East Bay, North Berwick, and having a northern aspect, the tamarisk is growing admirably; the plants are about 6 feet high, and present a better appearance than the fuchsias, buckthorns, and other plants in the neighbouring gardens. Notwithstanding its beauty, it is strange that this plant is still confined to one villa.

Difference of Climate in England and Scotland.—It is undeniable that the climate of England is very superior to that of Scotland. Such trees as *Catalpa syringæfolia*, *Paulownia imperialis*, *Gleditschia triacanthos*, and *Taxodium distichum*, cannot be grown in Scotland so well as in England. This, I believe, arises wholly from the deficiency of summer heat in Scotland, for standard trees of these plants are not killed by our winter cold, but the new wood, not sufficiently ripened during summer and autumn, is often killed during the winter.

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It is also known that the cold of winter, instead of being greater in Scotland, is in many parts not so severe as in England. Hence many plants, whose constitution renders them in a great measure independent of summer heat, can be grown in certain districts of Scotland as well as in England, such as *Yucca gloriosa*, *Y. recurva*, and *Y. filamentosa*; *Cordyline australis*, *Tritoma Burchellii*, and *T. Uvaria*; *Phormium tenax*, *Callistemon salicifolium*, &c. Neither is any difference observable in the growth and flowering of *Piptanthus nepalensis*, *Wistaria sinensis*, *Weigelia rosea*, *Jasminum nudiflorum*, *Cydonia japonica*, *Andromeda floribunda*, *Leycesteria formosa*, and *Garrya elliptica*, when compared with plants of the same species in English gardens.

All arboricultural observers who have travelled through England must have noticed the height of many of the English forest trees, particularly when standing alone on a level surface, as compared with those in similar positions in Scotland. Many of our Scotch trees seem dwarfed, rounded, and more twiggy at their points, as if a heavier atmospheric pressure rested on them than on the southern trees of the same species. This is particularly noticeable in the elm, ash, lime, plane, and sycamore. In Scotland, with the exception of the silver fir, few tall trees are seen to mount high except in deep rich dells.

The flowering of certain hardy deciduous trees does not necessarily follow a fine summer. The tulip tree (*Liriodendron tulipiferum*) and *Magnolia tripetala* are exotic trees which stand our climate well, and the wood, young or old, has never, to my knowledge, been injured, even during our coldest winters. The flowering of these trees, however, is very irregular. The tulip tree and *Magnolia tripetala* flowered freely during 1872, but no flowers were seen during 1871; this year (1873) no flowers were seen on the tulip tree, and the magnolia only produced a few, showing that in some cases it takes more than one year to ripen wood sufficiently to bear flowers and fruit.

The walnut is another exotic tree which grows admirably in Scotland; in some years producing fruit very scantily, and in others profusely. The flowering and fruiting of these trees do not always occur after a fine summer.

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During the years 1870 and 1871 walnuts were plentiful on standard trees, but few or none were seen at Edinburgh during 1872. It is generally observed that the fruit of our ordinary forest trees ripens best during a good season, but in all cases when it has been preceded by a warm summer.

Fruit Trees.—In the years 1828, 1831, and 1834, I saw the black Esperione grape produce clusters of fruit on a south wall at Edinburgh, as ripe and well coloured as during an ordinary season in England. In the same years the black mulberry was ripened to perfection. Although the mulberry not unfrequently produces fruit, I have never seen it in a state of maturity at Edinburgh, except in 1828, 1831, 1834, and 1868.

Figs used to be frequently grown on open walls in many districts of Scotland, but how rare it is now to see fruit thoroughly ripened without the aid of fire-heat. Figs, like the grape and mulberry, do not ripen during an ordinary warm season, unless it is preceded by a warm summer, and the wood has become thoroughly matured.

I need scarcely state that fruits which require hothouse culture to bring them to perfection, such as pine-apples, the finer kinds of grapes, peaches, apricots, nectarines, and figs, notwithstanding an unfavourable season, can be grown under artificial circumstances to as great perfection in Scotland, both as to size and flavour, as in almost any part of England.

The foregoing observations on the effects produced by climate lead me to notice an article on roses in the *Journal of Horticulture* for December 1871, advising observers in different counties of England to select, out of a list of thirty-six kinds, the names of twelve roses which succeed best in their particular district. This is a step in the right direction, and we want a similar investigation in Scotland for all open-air fruits, flowers, and vegetables.

Of late years the rage for novelties in the flower, fruit, and vegetable departments, has been on the increase, and nurserymen have much to do in endeavouring to supply the demand. It is well known that many novelties are produced in England, which are considered deserving of cultivation, and often highly lauded in advertisements. Such

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novelties, not always suitable for the climate of Scotland, become distributed over the length and breadth of the country, either by seeds, plants, grafts, cuttings, layers, or runners, and after many years of careful trial, finally fail.

If, as recommended for roses in England, central committees were formed to collect information in Scotland relative to the best hardy varieties of apples, pears, plums, gooseberries, strawberries, &c., and to ascertain which succeed best in each county, it might lead to securing in each particular district an annual supply of fruit fit for the table, instead of having a garden full of undoubtedly fine sorts, but which our Scotch climate is not sufficiently warm to mature. The wood of our finest apples, like the apples themselves, cannot be thoroughly ripened without heat. The trees become stunted in growth, and on the return of a fine summer the wood will be found so much injured that it is often impossible to get them into a good fruiting state again.

How often do we see brakes of gooseberry bushes, of the large fruiting Lancashire sorts, which rarely ripen fully in our most favoured Scotch counties, taking the place which ought to be filled by those varieties which are known to succeed well in a medium climate.

The strawberry has received much attention and has been considerably improved during late years. The improvement, however, has mostly been for the south. Many of the kinds recently introduced into our northern gardens, although growing freely, produce, except during a warm summer, but little fruit, in comparison with the sorts formerly cultivated; and I am sorry to find many of them rapidly disappearing to make room for novelties, which frequently turn out failures in our fickle climate. Many of the old free-fruiting sorts, producing smaller berries, are still to be had; it would in many cases be advisable to raise seedlings from them, in order to secure varieties that will suit some of our colder northern districts. Seedlings raised from the large southern varieties do not always produce so hardy a progeny as seedlings from sorts long proved to stand well in this country.

How often do we see in the amateur villa gardens throughout Scotland the finest varieties of named apple

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and pear trees, with high-sounding characters, selected from catalogues, or sent by first-class English nurserymen as very superior kinds. I have known numerous examples of first-class fruit trees being rooted out or cut down and re-grafted as bad, and this after many years of abortive trial, the want of fruit being due to deficiency of heat. It would be a great benefit if all our local or county nurserymen were to make themselves thorough masters of all the fruits which succeed best in their own districts, and propagate accordingly; and local nurserymen would do well to have a portion of ground set apart for maturing the kinds known to succeed best in their respective counties. Buyers would then see and judge for themselves, and thus save much disappointment to amateurs and gardeners.

Of what use would standards of the New York Pippin, Spitzenburg, or Blenheim Pippin be in many of our Scotch counties? I have seen the New York and Blenheim Pippins on Scotch walls, with fruit miserably small, deformed, and unfit for use. They are sorts for fine climates, requiring more sun than we can expect, to ripen the wood, still more the fruit. The same remark holds good with innumerable varieties now abundant in the middle districts of Scotland.

After these observations I recommend growers in each district to attempt the raising of seedlings, both apple and pear, from pips taken from kinds known to succeed in their particular locality; by this means we may in time see many of our northern gardens stocked with a variety of apples and pears having well-ripened wood and fruit, instead of trees stunted from the unpropitious climate, and eventually to be thrown out.

At one time experimental gardens existed in London and Edinburgh, for the purpose of testing all the newly introduced varieties of open-air fruits, and selecting the kinds to be recommended for growing in each respective country. To suppose that fruit proved suitable for London should be good in many districts of Yorkshire, or that those proved at Edinburgh would be adapted for many of our Highland districts, would be ridiculous.

With the aid of walls and espalier rails the case is different, as by their aid some of the less tender kinds can be ripened. Considering the mean temperature of Scot-

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land, I do not think it advisable to risk very tender varieties even on walls; the fruit of such kinds is often small and flavourless from want of sun-heat. It is well known that some of the fine stone fruit on unflued walls cannot be fully ripened as in former times, particularly peaches and nectarines. Flowers are produced in abundance, but little fruit comes to maturity. This also is attributable to the want of summer heat to ripen the wood sufficiently. Being weak, the blossoms, although produced in abundance, mostly fall off, unless they are protected from spring frosts by glass or heated walls.

Vegetables.— Besides fruits, there are several vegetables introduced into English gardens which are considered too tender for our ordinary Scotch climate, unless in favourable situations. Of peas many varieties have recently been raised and greatly extolled, but not more than they are entitled to, being in many cases great improvements on kinds formerly cultivated. But, like the gooseberries and strawberries, we are better off with the well-known old and proved hardy kinds than with the highly lauded new sorts. During a fine summer the produce of the new kinds may turn out good, but during a season like 1872 a large proportion of pea-straw is produced by some of these new kinds, with comparatively few pods.

The asparagus is another vegetable which in olden times was extensively grown throughout Scotland, but which of late years has become much more scarce, evidently from the want of sufficient summer heat to ripen the stems. In many new gardens asparagus beds are dispensed with altogether, owing to the extent of ground occupied, and the scanty crop produced. In former years Edinburgh was freely supplied with this vegetable by the market gardeners in the district; now it is mainly procured in the vegetable and fruit shops, the supplies being chiefly obtained from London. Many years ago a variety was introduced into our northern gardens, under the name of Giant Asparagus, which for several years was extensively planted. The general temperature of our climate was insufficient for it, and it gradually disappeared, as well as much of the ordinary kind which had been so long grown. Of late years many methods have been tried to produce a good crop of

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this favourite vegetable, such as the tying up of the summer-made shoots, instead of allowing them to blow about and break, which proves detrimental to the shoot of the following year, likewise giving the beds a coating of seaware. But notwithstanding the precautions used for the stems, and the manure supplied, our Scotch crop of this esculent does not increase.

The tomato is another esculent which in former years used to ripen and colour well, particularly against a south wall. Of late years it has rarely been seen with ripe fruit unless protected by glass.

It is doubtful whether the potato crop possesses the vigour it was wont to have. Occasionally, however, it is good. The fruits of the potato, or potato apples as they are called, are not produced in such abundance as formerly; except after a very fine summer, they are now of rare occurrence.

Between the years 1820 and 1830 mushrooms were abundant in many districts of Scotland, but few individuals took an interest in them, from the fear that they might not be the true sort. During the summers from 1823 to 1826 I was residing in the neighbourhood of Dollar, Clackmannanshire. All along the southern slopes of the Ochil Hills mushrooms used to abound. I have picked on a limited space two to three gallons in one morning. From information recently received, I learn that this favourite esculent is now rarely met with on these slopes. The same remark applies to other districts of Scotland where I had been in the habit of seeing them. During moist warm summers they are occasionally procured, but certainly not in the quantities formerly found; and this is due to the fact that the ground rarely gets sufficiently warm and moist for the growth of the spawn. In many districts of England, on the contrary, mushrooms are produced in abundance almost every year, and although large quantities are annually gathered for the market and for private use, no diminution in the supply is noticed, if the weather is at all favourable for them.

Acclimatisation. — Leaving the effects of climate on certain shrubs, fruits, and vegetables, I shall offer a few remarks on the acclimatisation of plants. This subject has

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long occupied public attention. I happen to be one of those sceptical individuals who do not believe it, and maintain that a plant is as hardy when first introduced as it is after half a century of cultivation. This, in a great measure, may be accounted for by our limited knowledge of the precise altitudes from which many plants were originally procured. It is well known that many plants of upper India, Australia, and New Zealand will stand with impunity two or three mild winters, and be killed during the third or fourth, but to suppose that such plants, after standing out for several winters, are sufficiently hardened always to stand unprotected is a mistake.

One of the plants often quoted as being acclimatised in this country, but chiefly in the Edinburgh Botanic Garden, is *Aponogeton distachyum*, which now grows vigorously in the pond. This plant is a native of the Cape of Good Hope, and was originally grown as a stove plant in the Edinburgh garden. It was afterwards cultivated in a large water-tank in the greenhouse, where it grew equally well. As the plant continued to increase rapidly, a quantity was placed by my father, forty years ago, in shallow pans and boxes, and sunk to various depths from $2\frac{1}{2}$ to 4 feet, in different parts of the pond. It now covers several spaces, the largest being about 24 square yards, and grows in the muddy bottom. It flowers abundantly every year, and even through a mild winter; but during a severe one it often dies down to its truncated fleshy rhizomes. From the apparent hardiness and profuse flowering, it is eagerly sought after by cultivators, but comparatively few succeed in growing it. The situation of the pond was originally a marsh; it was excavated to the depth of 2 to 5 feet. The bottom was composed of peaty clay, and full of springs. When the pond was made, the bottom was causewayed with stones fully half an inch apart, to allow the spring water to rise freely between them. The bottom has now a thick coating of mud produced from the fallen leaves blown into it every autumn. In consequence of the springs bubbling up in all directions through the mud in which the plants are growing, ice is rarely formed on portions of the pond. It is to these constant springs that I attribute the successful culture of the Aponogeton. If this plant had been placed

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in the pond when it originally came from the Cape of Good Hope, it would have succeeded as well as it did with the stove and greenhouse culture it received. Roots of Aponogeton have been sent to many ponds and lakes throughout the country, but with little success, except in those ponds treated with the condensed water from steam-mills, evidently from the want of constant springs.

Another example, recorded as the result of acclimatisation, is an old plant of a yellow flowering jessamine (*Jasminum revolutum*), a native of Madeira. The plant was for many years cultivated on the open wall. It was originally grown in a conservatory at the old Botanic Garden at Leith Walk, and was brought over to the new garden in 1822, and placed against the open south exposed wall, where it continued to thrive and flower in abundance until injured by the severe frost of 1837–38. It partially recovered, and formed new wood from the lower part of the plant; but although it grew freely for a time, it never regained its original vigour, and was finally killed by frost in the spring of 1841. This, with other examples, may be quoted to show that certain plants, although long grown in a conservatory and planted out while in full vigour, will thrive during a series of good seasons, but will succumb after an adverse summer followed by a severe winter.*

Hybridisation.—The subject of acclimatisation leads me to another important matter connected with open air vegetation. After the introduction of *Rhododendron arboreum* from India, fifty years ago, some of the original specimens, after being matured in the conservatory, were planted out in various parts of the country. With slight protection, some of these plants survived several winters, but finally died. It was then remarked that there was an end to scarlet rhododendrons being cultivated in the open air; but what could not be accomplished by acclimatisation was in eight or ten years successfully attained by means of hybridisation. We have not now *Rhododendron arboreum* itself in the open air, but we have its fine colours infused into the ordinary hardy varieties, particularly those introduced from Gibraltar, Switzerland, North America, and the Caucasus,

* For further remarks on acclimatisation of plants, see Balfour's "Class-book of Botany," pp. 682–3.

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which at the time alluded to were abundant in our gardens. The plants of *R. arboreum* cultivated in our conservatories soon flowered, and many set to work to produce hybrids, both by placing the pollen of the hardy kinds on the scarlet *R. arboreum*, and likewise by fertilising the hardy varieties with the pollen of the scarlet kinds. The hybrids of the first-named cross, taken from the *R. arboreum*, were by no means hardy, and the colours were not improved; while the latter crosses, using the scarlet rhododendron as the male, proved eminently successful, and three distinct breeds were soon in cultivation. One, between the *R. catawbiense*, a North American species, fertilised by *R. arboreum*, produced the varieties known as × *R. alta-clerense* and × *R. Russellianum*, with a host of others nearly allied, and known under the name of × *R. catawbiense arboreum*. The Gibraltar species *R. ponticum*, fertilised with the *R. arboreum*, produced the × *R. Cunninghamii*; also many other varieties very distinct in habit, colour of flowers, and shape of leaf, when compared with the *catawbiense* breed. The plants produced from the two last-named crosses have on several occasions been cut down by frost, but they always spring up again, which gives them more a bush form than a tree growth. Some, however, in sheltered situations, do grow to a large size, and frequently assume a tree-like habit.

Those plants raised between the Caucasian species *R. caucasicum*, fertilised with *R. arboreum*, are hardy and free-flowering. The ordinary *R. caucasicum* flowers abundantly in the open garden during January and February, and the numerous hybrids, generally known under the name of × *R. Nobleanum*, often flower in the open border during the same months. The hybrids between these species are now produced with certainty, and × *R. Nobleanum*, × *R. Cunninghamii*, or × *R. alta-clerense*, are easily procured. Many of the hybrids are now seed-bearing plants, fertilised both by hybrids and true species, and the varieties of rhododendrons are now endless. Bees have been instrumental in producing many excellent varieties.

Many species of rhododendron have been introduced from Sikkim and Bootan; some are comparatively tender, others grow freely in the open air: their young growths

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are, however, liable to injury by spring frosts, which makes them branch freely, and assume rather a bunchy appearance. The wood in consequence rarely ripens sufficiently to produce flower-buds, without conservatory treatment, excepting *R. ciliatum*, *R. glaucum*, and *R. anthopogon*, which flower abundantly in the open air. These are alpine forms, resembling in some respects the *R. ferrugineum* and *R. hirsutum* of Switzerland.

If a little trouble were taken, I do not see any difficulty in procuring interesting hybrids by crossing hardy European heaths with some of the Cape species, as has been done with the rhododendrons. Size and colour might thus be given to an interesting race of plants sufficiently hardy to stand the climate of Britain. A cross has been effected between *Menziesia empetriformis* and *Rhodothamnus chamæcistus*, well known in cultivation under the name of *Bryanthus erectus*—a name erroneously applied to a hybrid. The production of this variety shows that difficulties may be overcome by crossing some of the Menziesias with heaths, rhodoras, or dwarf rhododendrons. The hybrid was first raised by Mr James Cunningham, Comely Bank Nursery, and a similar hybrid was afterwards produced by Mr Anderson-Henry of Hay Lodge, from the same parents.

Evergreens.—Notwithstanding my remarks on the climate of Scotland, no one can deny that it ranks amongst the best in the world for evergreen shrubs, being neither too hot nor too cold for most of them. They are met with in Scotland in as great perfection as anywhere in England or Ireland; and, strange as it may appear, it is nevertheless true that certain exotic shrubs thrive in Scotland, while the deciduous trees from the same countries are more or less injured from the want of proper temperature.

Great Britain can boast of many indigenous evergreen plants, proving that it possesses a climate very suitable for them; and I believe that the climate enables us to cultivate many more species and varieties of hardy evergreen shrubs than any other country in the world. Although I have stated in this paper that, as regards the diminished vigour of certain plants, there seems to

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have been indications of a deterioration of climate, new species and varieties, imported, or produced by accident or experiment, are increasing rapidly in this country.

Evergreens, indeed, are not cultivated to the extent they ought to be. No doubt they are a little more expensive than deciduous shrubs. This extra expense is, however, well repaid by the clothed appearance they give to gardens and policy-grounds both in summer and winter. So much is this the case, that foreigners are always struck with the number and size of the evergreens cultivated in this northern portion of the British dominions. Such shrubs are comparatively scarce in France, Germany, and even America which furnishes us with some good evergreen shrubs, as *Kalmia latifolia, Rhododendron maximum, R. catawbiense;* but they are generally found indigenous in well sheltered woods, where the severe winter frosts cannot reach them. The same is the case with evergreens from European countries, where the summer climate is greatly superior to that of Great Britain.

During the past year the following additions have been made to the list of the Society:—

Foreign Honorary Fellow, . . .	1	
Foreign Corresponding Fellows, . .	8	
Resident Fellows, ...	10	
Non-Resident Fellows, . . .	2	
Lady Associate, ...	1	
Ordinary Associates, ...	2	
	—	29

The following losses have been sustained during the year:—

By Deaths, ...	14	
Resignations, ...	3	
Thomas Sansom, who died in March 1871, but overlooked, . . .	1	
	—	18
		—
Increase during 1872–73, . .		11

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The following is the Obituary for the year:—

JOHN BROWN died at Edinburgh in July 1873 at a comparatively early age. He had charge of the West Princes Street Gardens, and was Secretary of the Edinburgh Naturalists' Field Club. He added several plants to the Edinburgh Flora, and contributed a paper during the past session on "Localities for Plants near Edinburgh," *vide* Transactions, vol. xi. p. 427. He was elected an Associate on 12th December 1867.

GEORGE WILLIAM DAVIDSON, M.D., Ph.D., Professor of Anatomy in the Veterinary College, and Lecturer on Botany in the School of Arts, was elected a Resident Fellow of the Society on 9th April 1868. Dr Davidson was born in the manse of Cross and Burness, in the Island of Sanday, Orkney, on 5th June 1836. He was the eldest son of the Rev. George More Davidson, minister of the parish of Watten, Caithness, and received his early education at the parish school, coming to Edinburgh to study medicine when seventeen years of age. He died at Dick Place, Edinburgh, on 2d March 1873, of typhoid fever.

Miss ELIZABETH HARVEY was the daughter of the late Sir John and Lady Harvey, formerly of Carlton Terrace, Edinburgh. She was elected a Lady Associate of the Society on 30th July 1840. She died at Cambridge Street, Hyde Park, London, on 14th June 1873, at the age of seventy-five.

Biographical Notice of Professor Jameson of Quito. By ISAAC ANDERSON-HENRY, F.L.S., and R.S.E.

Professor WILLIAM JAMESON, one of our distinguished foreign correspondents, who died at Quito on 21st June last, was born in Edinburgh on the 3d October 1796. He was son of Mr William Jameson, W.S., and grandson of Mr Patrick Jameson, architect in Edinburgh, a very prominent citizen, who built the Royal Exchange, and effected the drainage of the city at a cost of L.100,000. This gentleman married a daughter of the late Sir William Nicholson of Jarviswood, Bart. The only son who reached manhood was

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the Professor's father. Of his father's family the Professor was the last survivor, except Mrs Paton, wife of J. G. Paton, Esq. of The Wild, near Broughty Ferry. By his will, Mr P. Jameson, the Professor's grandfather, to whom the greatest part of Portobello at one period belonged, left him a sixth part of his estate. About this property a lengthened lawsuit ensued, which was so protracted, and the expenses so enormous, that the grandson, whose father had destined him for the legal profession, took a disgust at law, and abandoned its study for that of medicine.

In 1814 he attended the Chemical and Natural History Classes of the University, taught respectively by Dr Thomas Hope and Professor Robert Jameson. At that time botany, his favourite and self-taught pursuit, was not so well understood and taught in Edinburgh as at present. His early taste for physical and natural science confirmed his predilection for the medical profession, by means of which, too, he indulged the hope of gratifying an early-formed desire for foreign travel. In pursuance of these views, he served an apprenticeship of three years to Messrs Bell, Russell, and Wardrop, the eminent practitioners of medicine and surgery in Edinburgh, at the same time attending the medical classes at the University. On 17th February 1818 he obtained his diploma from the Royal College of Surgeons of Edinburgh, and was immediately appointed surgeon to the whale ship "Thomas and Ann" of Leith, and sailed for Baffin's Bay in March. The ship, along with a numerous fleet of whalers, reached Hare or Waygat Island about the middle of June, where farther progress was obstructed by an impenetrable barrier of ice. Among the vessels so detained were H.M.'s ships "Isabella" and "Alexander," commanded respectively by Captain Ross and Lieutenant Parry.

It proved an uneventful and unprofitable voyage. They captured but three whales, and the raw, misty weather of August forewarning them of early winter, they turned their course homeward, and reached Leith in the beginning of September. But their detention at Hare Island, and afterwards at various points of the coast on their voyage northward, afforded Jameson an opportunity of collecting and investigating specimens of the flora of that region, to him

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a greater conquest than the capture of a whale. An account of the Arctic flora which he observed, and a list of the specimens he brought home, will be found in the "Memoirs of the Wernerian Natural History Society," vol. iii. p. 416. The *Potentilla* (named *P. Jamesoni*) figured and described at p. 417, turned out not to be a new species, but the *P. nivea* of the "Flora Danica."*

In the following year (1819), Jameson was enabled to devote more time to the study of natural and physical science. He attended a second course of lectures on natural history, including mineralogy, accompanying the Professor, with whom he was a favourite pupil, to some interesting localities near Edinburgh. Long before this, viz. in 1816 and 1817, when a student of medicine, he was during summer vacations in the habit of travelling on foot and visiting the romantic scenery of Ben Lomond and Ben Lawers, whose lovely alpine flowers he recognised with pleasure on his return to this country in 1870, after an absence of half a century.

He made a second voyage to Baffin's Bay in a whale ship which sailed from Hull in April 1820. In the matter of *fish*, they were on this occasion more successful, capturing and "flensing" several large whales, a work sufficiently exciting, but requiring the captain and officers to be constantly on the "look-out." In this voyage, which lasted over five months, he had a brief opportunity of landing on one of the "Duck Islands" (lat. 74°), so named from the vast number of eider ducks that there congregate for incubation. The more interesting species of plants he then observed were—*Salix arctica* and *S. herbacea*, *Potentilla frigida* (?), *Andromeda tetragona*, and *Papaver nudicaule*. (For an account and list of these see "Memoirs of the Wernerian Nat. Hist. Society," vol. iii. p. 422.)

Jameson having finished his education, held himself ready for any engagement by which he could carry out his cherished desire of visiting other lands. He did not long

* In his printed notes (in Spanish) appended to his work on the Natural Orders of the Ecuadorean Flora, Dr Jameson referred, from personal observation, to the occurrence or absence of certain arctic genera and species compared numerically with or represented by allied families found wild on the snowy ridges of the Andes.

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wait for an opportunity. Through a fellow-student he was introduced to Captain Robson, who had been engaged in the South American trade, and was then preparing to sail from London for ports on the coast of Peru.

In December 1820 the good ship "Fifeshire," Robson owner and master, Jameson, surgeon, sailed from the Thames, bound for various South American ports in possession of the patriots, Callao being her ultimate destination. The voyage was not a prosperous one. After a stay of some weeks at Rio, and cruising about, they sighted the port of Cobijo, where, finding it apparently in possession of the Spaniards, they moved on to Arica, and thence to Callao, which they reached in June. There more serious evils awaited them. The captain had a bad market, the place being already glutted with European goods, and the cargo of brandy he had ready on the beach for their return voyage, was entirely demolished by hostile Spaniards, who, with the butts of their carbines, smashed the earthenware vessels in which the brandy was stored. By this disaster the captain was virtually ruined. His creditors seized the vessel in satisfaction of their claims, they, however, providing the passage of himself and family to London. And though Jameson might have accompanied them, he preferred remaining for a time at Lima, and ultimately he went to Guayaquil. There, being hospitably received and professionally consulted, he continued for some time enjoying the friendship of various parties, and notably of Mr William Wheeler of the U.S. Consulate. But finding, after a residence there from 1822 to 1826, that the hot climate of that city did not agree with him, and having had an attack of fever, he, by advice, left for the cooler and more salubrious air of Quito, the capital of Ecuador, one hundred miles off, and 9650 feet above the sea-level, where he was resident in all for forty-four years. After practising in Quito for about a year, he was, in 1827, appointed Professor of Chemistry and Botany in the University, both of which chairs he held till he left the country. In 1832 he was appointed Assayer of the Mint. On its re-establishment in 1861, after its suspension owing to changes in the Government, he was made Director and Treasurer as well as Assayer of the Mint.

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In 1835 Professor Jameson communicated to Sir William Hooker "Physical and Geographical Observations made in Columbia." This interesting paper is recorded in the Comp. to the Bot. Mag. i. p. 111–116.

In 1863 a notice of the ink plant of New Granada (*Coriaria thymifolia*) in a letter from him, was communicated to the Linnean Society, and is recorded in their Journal, vol. viii. p. 120.

In 1864 he was appointed by the Ecuadorean Government to undertake, at its expense, a botanical exploration, and to write a *synopsis* of a *flora* of the country, an undertaking which was much impeded from the inefficiency of the press in Quito. Two volumes and a part only of the third were printed at the time he left Quito in 1869, when a complete revolution took place in the University. But I am glad to learn that the synopsis may be completed by his friend Professor Orton of Vassar College, New York, the accomplished author of an able work on "The Andes and Amazon," published in 1870, who had visited Quito in 1867, and who with a view to that object applied for and obtained the dried specimens left by Dr Jameson, in charge of the U.S. Consulate in Quito, at the time of his departure from that city.

Of the two volumes of the synopsis then published, the following notice was given in the "Athenæum" of 17th July 1869:—"*Synopsis Plantarum Æquatoriensium*, auctore Gulielmo Jameson in Universitate Quitensi Botanicus Professor, vols. i., ii. (Quito).—The unpretending little volumes here announced demand more than a passing notice from the cultivators of botany and horticulture, dealing as they do with a flora of surpassing beauty, variety, and interest, and which, since the works of the illustrious Spaniards, Ruiz and Pavon, and of the still more illustrious Humboldt and Bonpland, has received no systematic treatment at the hands of botanists. The author, Dr William Jameson, is Professor of Botany in the University of Quito, and has for upwards of forty years laboured incessantly in the flora of his adopted country, with a zeal, intelligence, and energy that are beyond all praise, extending his explorations beyond the humid, pestilent swamps of the torrid coast line to the everlasting snows of Chimborazo, Pichincha, and

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Cotapaxi, and enriching the gardens and museums of Europe, and especially of Great Britain, with his discoveries. It is not often that the labours of scientific men, in the American tropics, meet with appreciation, or even recognition, from their own Governments. The contrary, however, has been notably the case in two countries in South America, as instanced in the publication by the Chilian Government of Gay's 'Historia Politica et Fisica de Chile,' and more recently in the patronage extended by the Emperor of Brazil to Agassiz, and his support of the magnificent 'Flora Brasiliensis' of Von Martius. Such examples are sure to be followed; and we recognise with pleasure the action of the Government of Ecuador in defraying the cost of printing this, the first botanical work ever issued from the press of Quito. To value these little volumes from their size would be a great mistake. They not only form the commencement of a very important work, but they are, farther, exceedingly well done, and will give Professor Jameson a very distinguished place among contemporaneous botanists. In point of bulk and appearance the 'Flora of Ecuador' is a contrast to the expensively illustrated *ouvrages de luxe* which usually boast of Government aid, and which, from their cost, are all but inaccessible to the majority of naturalists, and, from their bulk, wholly so to the travellers, whom they should most of all benefit; but, in point of utility and portability, the contrast is greatly in its favour, since it is very moderately priced, and of duodecimo size. To publish a companion volume of plates would be an act worthy of the Government of Ecuador and of its beautiful flora, which surely merits such a distinction. In conclusion, we have only to express a hope that Professor Jameson may receive not only the encouragement which the nature of his subject demands, but also a recompense worthy of an enlightened and liberal Government."

Of the same work Dr Philippi, Professor of Botany in the University of Santiago de Chile, the learned and eminent author of *Plantarum Novarum Chilensium centuriæ duodecim in Linnæa*, wrote a highly favourable review, characterising the synopsis as in his opinion of greater merit and ability than the more expensive work then lately published on

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the Flora of Chili at the expense of the Government of that Republic.

A report by Dr Thomas Taylor on "New Mosses collected by Professor W. Jameson in Pichincha," is given in the Lon. Jour. Bot., vol. vii. (1848), pp. 187–199, and pp. 278–285.

Having his eldest and two other sons settled in the Argentine Republic, Dr Jameson was induced by the former, who had been on a visit to Quito, to accompany him thither. He accordingly left that city, in which he had resided for forty-four years, along with his son, in November 1869.

After a residence of nearly two years, first at San Juan and afterwards at Jachal, he paid a visit to his sister, Mrs Paton, in this country. Here he delighted to visit the scenes in and about Edinburgh, where he had passed his early life, and where now he formed the personal acquaintance of some of those he had long been in correspondence with. He was especially gratified to make the acquaintance of Professor Balfour and others devoted to botanical pursuits about Edinburgh, and not less so, on his visiting London, to be entertained by Dr Hooker, the son of his distinguished friend the late Sir William Hooker, and to meet at his table Mr Bentham, the President of the Linnean Society.

He finally took farewell of his Edinburgh friends on 27th November 1872, at a dinner given on the occasion, at which Professor Balfour and other botanical gentlemen were present. He left next day for Liverpool, from which port he set sail on his return voyage. The voyage was disastrous; the ship was overcrowded. "Without including passengers," he writes me, "who embarked at Liverpool, there could not be less than 1100 French, Spaniards, and Portuguese emigrating to Brazil," &c.; "and so great was his discomfort," he adds, that but for "the kindness of a fellow-passenger and countryman, Mr Scott of Valparaiso, I believe I should not have survived the voyage," for the weather, too, had been adverse. He reached Valparaiso on 11th January 1872, much shaken, and in a very weak state of health. To add to his troubles, he found that a son, whom he expected to find settled in that city as a merchant, had met with losses, and been obliged to remove with his family to Mendoza, some hundreds of miles distant. He also

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heard of the death of his eldest son at Jachal, in San Juan, in the Argentine Republic, on 2d December preceding, and in his feeble state he found himself unable to journey further, and went for a time into lodgings; on 15th January, he wrote "I am lodged in a comfortable apartment in a quiet and retired part of this thoroughfare, where I am gradually recovering my usually good health. But I cannot, for one month, at least, undertake my usual botanical explorations."

After communicating with his son at Mendoza, he found his best course was to return to Quito. Accordingly, on finding himself fit for the journey, he sailed for Guayaquil, where, after a brief sojourn among his former friends, he continued his journey to Quito. At one of the stages on the way he wrote to me, mentioning some incidents of his journey, and that he meant to make a slight detour on his route, to procure some seeds or plants peculiar to that place. This was on the 14th of June, and it was perhaps the last letter he ever wrote; for on his reaching Quito, in a few days thereafter, the fever which he had caught in Guayaquil manifested itself. Its progress was fearfully rapid, and he died on 22d June, surrounded by his three daughters who had never left that city. His return, so unexpectedly, to the place where the greater part of his life had been passed just as it were to die, and his rapidly fatal illness and sudden death, excited much sympathy among the inhabitants of Quito, who, from the President downwards, manifested their estimation of the departed citizen by their attendance at his funeral. He was alike esteemed and beloved by all classes; and none perhaps had ever passed so peacefully away from among them with so many friends and so few enemies. All who knew him will bear like testimony. Like many other men distinguished in science, he was gentle, amiable, and obliging to all, and his name must ever stand in the foremost rank among the men of science, of whom Humboldt was the leader, who communicated to the world all that is yet known of the natural history of that most interesting region. One memorable event in his life falls to be added. Just about a year before her abdication, Queen Isabella, as a token of the high estimation in which he

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was held as a man of science, conferred on him the distinguished honour of Caballero of Spain.

During his long residence in the Republic of Ecuador, Dr Jameson kept up a regular correspondence with his friends in England, Germany, and America—with such men as the late Sir William Hooker, Dr Hooker, the late Professor Lindley, Professor Balfour, Sir William Jardine, Mr Gould, Mr Andrew Murray, Professor Reichenbach of Hamburg, Professor Orton of America; and from 1850 to the period of his death, I enjoyed a regular, almost monthly, correspondence with him. And many are the rare birds, plants, and specimens of natural history he was instrumental in introducing into Europe.

From seeds communicated to me since 1850, I was successful in raising the following, among others:—

Hypericum laricifolium.
Calceolaria chelidonioides, Lindley and Paxton's Flower-Garden, vol. ii. p. 143, in 1852.
C. ericoides.
Pitcairnia pungens, Bot. Mag. tab. 5356.
Micranthella Candollei, Bot. Mag. t. 5455, in 1864.
Calceolaria hyssopifolia, Bot. Mag. t. 5548, in 1865.
Pleroma sarmentosa, Bot. Mag. t. 5629, in 1867.
Draba violacea, Bot. Mag. t. 5650, in 1867.
Delostoma dentatum, Bot. Mag. t. 5754, in 1869.
Tacsonia eriantha, Bot. Mag. t. 5750, in 1869.
Calceolaria Henrici, Bot. Mag. t. 5772, in 1869.
Tacsonia quitensis, Bot. Mag. t. 5876, in 1870.
Fuchsia sessilifolia, Bot. Mag. t. 5907, in 1866.
Brachyotum confertum, Bot. Mag. t. 6018, in 1873.
Gaultheria insipida, Bot. Mag. t. 6070.

In addition to the above a list is here appended of Ecuadorean plants sent to the Kew Herbarium, which are figured in Hooker's "Icones Plantarum:"—

RANUNCULACEÆ.
Anemone Jamesoni, vii. 670.
Ranunculus peruvianus, viii. 745.

CRUCIFERÆ.
Cremolobus peruvianus, i. 48.
Draba violacea, i. 35.

VIOLACEÆ.
Viola glandulifera, i. 67.

MALVACEÆ.
Sida parnassiefolia, iv. 385.

OXALIDACEÆ.
Oxalis lotoides, vii. 661.

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TROPÆOLACEÆ.

Tropæolum tuberosum, vii. 653.

LEGUMINOSÆ.

Lathyrus gladiatus, i. 72.

ROSACEÆ.

Hesperomeles heterophylla, v. 846.
Rubus rosæflorus, i. 46.

ONAGRACEÆ.

Fuchsia dependens, i. 65.

UMBELLIFERÆ.

Eryngium humile, var. caulescens, iii. 216.

LORANTHACEÆ.

Loranthus albiflorus, vii. 683.
macranthus, viii. 743–4.

COMPOSITÆ.

Baccharis ferruginea, viii. 750.
Scolopendra, i. 68.

LOBELIACEÆ.

Siphocampylus giganteus, viii. 716.

VACCINIACEÆ.

Vaccinium muscicola, viii. 717.

ERICACEÆ.

Gaultheria lanigera, i. 66.
tomentosa, iv. 393.

MYRSINACEÆ.

Myrsine myrtoides, v. 877.

GENTIANACEÆ.

Gentiana Jamesoni, i. 61.

SOLANACEÆ.

Cestrum vestitum, i. 381.
Lycium quitense, viii. 723.

ACANTHACEÆ.

Aphelandra carduifolia, viii. 718.

ORCHIDACEÆ.

Pleurothallis cauliflora, i. 50.
truncata, i. 55.
Stelis lamellata, i. 62.
Stenoglossum subulatum, i. 51.

COMMELYNACEÆ.

Tradescantia gracilis, vii. 654.
hirsuta, vii. 665.

JUNCACEÆ.

Juncus andicola, viii. 714.

FILICES.

Acrostichum cardiophyllum, viii. 715.
caudatum, iii. 215.
lloense, vii. 657.
tambillense, vii. 656.
Asplenium fragile, x. 932.
fragrans, i. 88.
Jamesonia cinnamomea, viii. 713.
Polypodium chrysolepis, viii. 721.
farinosum, x. 947.
murorum, i. 70.
onustum, viii. 749.
piligerum, iv. 321.
punctulatum, viii. 720.
semiadnatum, x. 948.
subcrenatum, viii. 719.
surucuchense, i. 69.
Trichomanes montanum, ii. 187.

LYCOPODIACEÆ.

Lycopodium compactum, iii. 244.
Pichinchense, i. 85.
rufescens, i. 36.

MUSCI.

Bryum pellucens, i. 34.
Dicranum Jamesoni, ii. 179.
macrodon, iv. 319.
Leucodon bartramioides, i. 71.

A beautiful genus of ferns was named *Jamesonia*, in honour of our friend. *J. pulchrum* is figured in Hooker and Greville's "Icones Filicum," t. 178. and other species by Kunze.

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JUSTUS LIEBIG was born on the 12th May 1803, at Darmstadt. He early showed a strong inclination to the study of experimental chemistry, and was sent, at the age of fifteen, to an apothecary's shop at Heppenheim to learn pharmacy. There he remained only ten months, and returned to Darmstadt. He remained at home for some months preparing for a university course, upon which he entered, in 1819, at the University of Bonn. He soon left Bonn for Erlangen, where he studied chemistry under Kastner.

Assisted by the liberality of the Grand Duke Louis of Hesse, he proceeded to Paris, and worked in Gay-Lussac's private laboratory. He attracted the notice of Humboldt, who was then resident in Paris, and was appointed, in 1824, Extraordinary Professor of Chemistry in the University of Giessen. In 1826 he was raised to the ordinary professorship. In 1845 the Grand Duke of Hesse conferred upon him the title of Baron von Liebig. In 1852 he accepted the invitation of the Bavarian Government to the ordinary Professorship of Chemistry, and the Directorship of the Chemical Laboratory in the University of Munich. He died 18th April 1873 at Munich. He was elected an Honorary Fellow of the Botanical Society on 10th June 1841.

ROBERT MACKENZIE STARK was the son of the Rev. William Stark, minister of the parish of Dirleton, East Lothian. He was the author of a "Popular History of British Mosses," and followed the occupation of a nurseryman for many years in Edinburgh. He was elected a Resident Fellow of the Society on 11th March 1841. He died at 7 Grafton Street, London, on 29th September 1873, aged fifty-eight.

WILLIAM MITCHELL, city missionary, died at 15 Upper Grove Street, Edinburgh, on 10th April 1873. He was elected an Associate of the Society on 9th December 1858, and contributed several papers, which are printed in the Transactions, including "Serial Internodes of Plants" (vol. vi.), "Measurements of Axial Appendages of Plants" (vol. vi.), "Trichotomous Arrangements of Plants" (vol. vi.), and on "The Equations of the Curved Outlines of the Leaves of Plants" (vol. x.).

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CHRISTOPHER CURRIE RITCHIE, M.D. and C.M., son of William Ritchie, cattle-dealer, was born in Edinburgh on 13th December 1842, and there his early education was carried on. In 1863 he commenced his medical studies at the University of Edinburgh, and gained many honours in his classes. He was dresser and clerk in the clinical surgery wards, and for nine months clerk in the medical wards. He joined the Botanical Society of Edinburgh on 12th January 1865. In 1867 he took the degrees of M.B. and C.M. with honours, and was appointed physician's assistant to the Edinburgh Royal Hospital for Sick Children. Afterwards he studied for a few months in the hospitals of London and Paris, and was, in the spring of 1868, appointed house-surgeon to Professor Syme's wards in the Edinburgh Royal Infirmary. At the end of his period of office he acted for nearly a year as resident physician's assistant to the Manchester Royal Infirmary. In 1869 he graduated as M.D. Edinburgh, and on leaving the Infirmary settled in Moss-side, Manchester, and was elected honorary physician to the Hulme Dispensary. He was afterwards appointed honorary secretary of the Manchester Medical Society, and became a fellow of the Pathological Society of London. Early in 1873 he was elected assistant physician to the Royal Infirmary, Manchester.

On the evening of 26th July 1873 he went a couple of miles to see a patient for another doctor. He returned about 11 P.M., and complained of being tired. He was called again to the same patient about 1.30 A.M. on the 27th, and he remained with the child all night, and seemed quite exhausted on his return at 9 A.M. He and Dr J. W. Paton went to Dr Glascott's after breakfast, where, about 12.30, Dr Ritchie complained of pain in the bowels. This became worse in spite of suitable treatment, and he sank from enteritis, and died about 6.30 A.M. on 30th July 1873, at the residence of Dr Glascott, 21 St John Street, Manchester. He was interred at Spott, Dunbar. Dr Ritchie wrote his graduation thesis on "Keratitis;" and he contributed to the British Medical Journal, "Memoranda on Herpes Cornox;" to the Lancet a paper on "Intermittent Tetany;" to the "Medical Times and Gazette" one on "Rickets;" and to "The Practitioner" an article on "The Hypodermic Injection of

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Ergotine in Hæmoptysis." He also edited the second edition of Dr Roberts's work on "Urinary and Renal Diseases," and the Supplementary Catalogue of the Library of the Manchester Medical Society.

THOMAS SANSOM, Custom-house, Newcastle, died in March 1872; but his obituary was overlooked last year.

Obituary Notice of Dr John Lindsay Stewart.
By H. CLEGHORN, M.D.

Indian Botany has been deprived of one of its most diligent workers by the death of Dr John Lindsay Stewart, late Conservator of Forests in the Punjab. Dr Stewart was a native of the parish of Fettercairn, Kincardineshire. He obtained his medical education in Glasgow, where he was a pupil of the late Professor G. A. Walker Arnott. After taking the degree of M.D. at the University of Edinburgh, he became a candidate at the first competitive examination for admission to the Indian Medical Service, and out of forty-two applicants he was fifth on the list. In 1856 he proceeded to the Presidency of Bengal as assistant-surgeon, and was present at the siege, assault, and capture of Delhi in 1857. In 1858 he joined the expedition to the Yuzufzai country, and served for some time with the 14th Punjab N. I. In 1860–61 he officiated for Dr W. Jameson as Superintendent of the Botanic Garden, Saharunpore and of the Government Tea Plantations in the Nort-Western Provinces and the Punjab. On Dr Jameson's return to India he was appointed Civil Surgeon at Bijnour in Rohilkand, and in 1864 he was employed in arranging a system of forest conservancy in the land of the five rivers.

During the whole of his Indian service Dr Stewart devoted all his spare time to botanical pursuits. His position at Saharunpore gave him an excellent opportunity of becoming acquainted with the vegetation of the Terai and North-West Himalaya, and afterwards at Bijnour he studied the Flora of the Rohilkand forests, and of the outer valley between the Ganges and Sardah. As Conservator of Forests in the Punjab, his duties took him to all parts of that province, and he extended his journeys to the adjoining

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province of Sindh, to Kashmir, and to the arid, treeless, but botanically most interesting inner Himalayan tracts on the Upper Indus, Chenab and Sutlej rivers, which adjoin Turkistan and Tibet. His wiry frame and indefatigable energy enabled him to accomplish much rough travelling, and few Europeans or natives of the country were able to keep up with him in walking and climbing. During his journeys, under the most difficult circumstances, he maintained with great persistance his habit of taking copious notes on the spot, and in this manner he accumulated an immense store of valuable information regarding the natural history, the properties, uses, and vernacular names of the plants of North-West India. The results of these researches are embodied in numerous papers (of which a list is appended) published in the journals of various Societies. His official reports while at the head of the Forest Department in the Punjab contain the record of a large number of accurate observations on the arborescent vegetation of that province; and in 1869, before coming home on furlough, he published a most useful work on the trees, shrubs, and herbaceous plants of economic value growing in the Punjab. This work, entitled "Punjab Plants," contains systematic and vernacular names and notes on the geographical distribution and uses of upwards of 800 species. In another respect, also, Dr Stewart rendered great service to the cause of forest administration in India, for he commenced the large and now flourishing fuel and timber plantations in the plains of the Punjab.

In 1869, after twelve years of unremitting labour, mental and bodily, Dr Stewart returned to England on furlough, to recruit his strength and to refresh his memory on professional and scientific matters; and the Government of India entrusted him with the preparation at Kew of a Forest Flora of Northern and Central India. To this great work, which purposes to give an account of the natural history of the trees and principal shrubs and climbers in the forests, Dr Stewart devoted a large part of his furlough, but he was obliged to return to India before it was completed.

He was naturally of a highly nervous temperament, and during the latter part of his residence in England it was evident to his friends that his general health was much

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impaired. This was further apparent on his return to India, when, after a few months of office work, sickness obliged him to move (June 1873) from Lahore to the Hill Sanitarium at Dalhousie, where he gradually sank from paralysis on the 5th July, aged forty-one, his old friend and school-fellow, Dr Fairweather, waiting on him in his last illness. He was buried under an oak tree in the Dalhousie Cemetery. One of his last requests was that his Herbarium and MSS. should be sent to his Alma Mater, the University of Glasgow. He had when in this country presented a large collection of North Indian plants to the Herbarium of the Edinburgh University, and the MS. used in the preparation of the "Forest Flora" is deposited in the Library of the Royal Herbarium, Kew.

Dr Stewart was kind and generous to all who required his help, and his loss is regretted by a large number of friends in India and in this country. He was a member of numerous learned Societies, among others of the Royal Society of Edinburgh, and of the Royal Geographical and Linnean Societies. He was elected a Fellow of the Botanical Society in 1869.

Botanical Writings.

1. Memorandum on the Peshawur Valley and its Flora. Jour. As. Soc. Beng., 1863.
2. Notes on the Flora of Waziristan. Jour. R. Geog. Soc., 1863.
3. The Sub-Sewalik Tract, with special reference to the Bijnour Forest and its Trees. Jour. Ag. Hort. Soc. of Ind., vol. xiii., 1865.
4. Journal of a Botanising Tour in Hazara and Kaghan. Jour. A. H. Soc. of Ind., vol. xiv., 1866.
5. Trees in the Punjab Salt Range. Jour. A. H. Soc. of Ind., vol. i., N.S., 1867.
6. Forest Conservancy in the Punjab. Calc. Review, June 1867.
7. Railway Fuel in the Punjab. Calc. Review, February 1868.
8. Punjab Plants. 8vo, Lahore, 1869.
9. Notes of a Botanical Tour in Ladak and Western Tibet. Trans. Bot. Soc. Edin., vol. x., 1869.

JOSHUA SUTCLIFFE, Fir Grove, Burnley, Lancashire, died on 10th February 1873. He was born at Halifax, Yorkshire, on 10th April 1812. He studied medicine, and be-

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came a member of the Royal College of Surgeons of England in 1835. He entered the Botanical Society on 11th March 1841, and was elected a Fellow of the Linnean Society on 6th May 1834.

Robert W. Thomson, C.E., was born in the town of Stonehaven in 1822, and by sheer force of character, without any adventitious aid, rose to be a leader in his profession and a benefactor to his country. He was a distinguished engineer and inventor. When only sixteen years old, he conceived the idea of the ribbon saw, afterwards worked out by other hands; and the elliptic rotary steam-engine. In 1862 he invented that by which he is most widely known, viz., the Road Steamer—a name given by him to a traction engine having thick india-rubber tyres on the driving wheel. For the last five years of his life he was constantly confined to the sofa or his bed, having lost the power of walking. He died at his house, 3 Moray Place, on Saturday, 8th March 1873, aged fifty. He was elected a Resident Fellow of the Society on 13th April 1865.

John Torrey, M.D., LL.D., one of the Honorary Fellows of the Society, died on the 10th March 1873, from an attack of pneumonia. He was born in New York in 1796, and prosecuted his studies in that city. He early showed a taste for botanical pursuits, and in 1819 gave an account of the New York Flora. He subsequently published a Flora of the United States north of the Potomac. He gave an account of the plants of the Rocky Mountains, and a catalogue of the North American Geums. He was associated with Dr Asa Gray in preparing their great Flora of North America. He published also numerous botanical treatises on special American plants. The genus *Torreya* was named in compliment to him by the late Dr Walker Arnott. Besides being a good botanist, Dr Torrey was also a successful chemist, and gave lectures both on botany and chemistry in the Medical College of New York. He subsequently resigned his office as a teacher, and became connected with the Government Assay Office. He gave his botanical collection and books to Columbia College. He was

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elected an Honorary Fellow of the Society on 9th February 1837.

Robert Traill was born in the parish of Maryton, near Montrose, on 24th January 1796, and died at Aberlady Lodge, near Drem, after twelve days' illness, of inflammation in the lungs, on 1st November 1873. From infancy he showed an intense liking for flowers. This taste he seems to have inherited from his father and grandfather, both of whom took great delight in gardening. For the last fifteen years, at least, he devoted most of his time to his garden and greenhouse, and took special pleasure in rearing geraniums, fuchsias, and auriculas, of which he possessed a very large and varied collection. He took a deep interest in the Infirmary and the Lunatic Asylum in Montrose, of both of which institutions he was a director for many years. He was devotedly fond of reading all his life—principally history, travel, and biography—and possessed a very large amount of general information. He was elected a Resident Fellow of the Botanical Society on 13th April 1865, and although in his seventy-seventh year, he attended frequently the meetings of the Society.

James Ward was elected a Fellow of the Society on 12th May 1836, and contributed largely to the Society's Herbarium. For upwards of fifty years Mr Ward made British plants his study, and few of his contemporaries were more accurately acquainted with them. Up to the last, though afflicted with a painful and crippling disorder, his mind was clear and his love for plants unabated. He was an active promoter of the Richmond Naturalists' Field Club, and a valuable Herbarium belonging to that club was mainly formed through his exertions. Mr Ward was remarkable for keenness of observation, rarely failed to find what he was in search of, and never was backward in imparting to his friends a share of his spoils. At different periods of his life he visited Switzerland and Ireland in search of plants, and delighted in cultivating in his garden some of the rarities he had met with in excursions both at home and abroad. For many years he resided at Richmond, in Yorkshire, where he was engaged in business, and after his

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retirement from business he removed to Redcliffe House, near Manchester, where, after a long and painful illness, which latterly assumed the form of carditis, he died on 7th March 1873, in his seventieth year.

FRIEDRICH WELWITSCH was born in 1807 in Carinthia, in the Austrian empire, where his father was the owner of an extensive farm. He died in London in October 1872. He was elected a Foreign Member of the Society in January 1866. A full obituary, with portrait, of Dr Welwitsch is given in the "Journal of Botany," vol. ii. (New Series).

Miscellaneous Communications.

1. Mr Wm. W. Robertson, Carolside, Earlston, exhibited a section of a stump of a larch tree, cut down upwards of thirty years ago, and which had continued to increase by additions of wood on the outside, year by year, ever since. At the request of Mr Sadler, he had traced the roots proceeding from the stump, and found them to be engrafted into the roots of another larch, growing about three feet distant.

2. A letter was read from Dr Thomas Mawson, dated from Nickerie, Surinam, giving some account of the vegetation of that district, and offering to send dried specimens of the plants met with growing wild on the dams between the brakes in the sugar-cane fields, and also a paper on the cultivation of the sugar-cane and sugar manufacture.

3. Dr Robert H. Ramsay communicated a list of sixty species of plants which were in flower in his garden at Duncan House, Torquay, on 12th November.

4. Mr Andrew T. Jaffray presented to the University Herbarium a series of dried specimens of the different species and varieties of Cinchona cultivated in the Government plantations at Darjeeling; he also presented specimens of the barks to the museum of the Royal Botanic Garden. —Mr Andrew Brotherston, Kelso, presented specimens of plants collected in that neighbourhood, including many species which had been introduced with wool, and become naturalised.

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11*th December* 1873.—WILLIAM CRAIG, M.D., C.M., Vice-President, in the Chair.

The following Gentlemen were elected Office-Bearers for 1873–74:—

President.

Sir ROBERT CHRISTISON, Bart., M.D., D.C.L., Professor of Materia Medica.

Vice-Presidents.

WILLIAM CRAIG, M.D., C.M.
JAMES M'NAB.
Sir WALTER ELLIOT, K.S.I., F.L.S.
Professor DICKSON, M.D., F.R.S.E.

Councillors.

J. K. DUNCANSON, M.D., C.M.
CHARLES JENNER, F.R.S.E.
A. P. AITKEN, M.A., D.Sc.
PATRICK D. SWAN, F.R.S.E.
HUGH CLEGHORN, M.D., F.R.S.E.
ALEXANDER HUNTER, M.D.
DAVID GRIEVE, F.R.S.E.
WILLIAM GORRIE, F.R.Cal. Hort. Soc.
ISAAC ANDERSON-HENRY, F.L.S., F.R.S.E.
THOMAS A. G. BALFOUR, M.D., F.R.S.E., F.R.C.P.E.

Honorary Secretary, . Professor BALFOUR, M.D., F.R.SS. L. & E.
Honorary Curator, . . The PROFESSOR of BOTANY.
Foreign Secretary, . . Professor MACLAGAN, M.D., F.R.S.E.
Treasurer, ... PATRICK NEILL FRASER, F.R.Cal.Hort.Soc.
Assistant Secretary, . . JOHN SADLER, F.R.P.S.

Local Secretaries.

WILLIAM CARRUTHERS, F.R.S., British Museum, London, W.C.
ALEXANDER DICKSON, M.D., Professor of Botany, Glasgow.
GEORGE DICKIE, M.D., Professor of Botany, Aberdeen.
W. R. M'NAB, M.D., Prof. of Bot. Roy. Col. Science, Dublin.
PHILIP W. MACLAGAN, M.D., Berwick.
CHARLES C. BABINGTON, Professor of Botany, Cambridge.
THOMAS SHAPTER, M.D., Exeter.
JAMES GILCHRIST, M.D., Dumfries.
WILLIAM KEDDIE, 5 India Street, Glasgow.
JOSEPH DICKSON, M.D., St Heliers, Jersey.
BENJAMIN CARRINGTON, M.D., Eccles, Manchester.
WILLIAM ALEX. STABLES, Cawdor Castle, Nairn.
EDWARD CHARLTON, M.D., Newcastle.
JOHN LOWE, M.D., King's Lynn, Norfolk.
F. BUCHANAN WHITE, M.D., Perth.
Rev. W. A. LEIGHTON, Shrewsbury, Shropshire.
J. F. ROBINSON, Frodsham, Cheshire.
JAMES HECTOR, M.D., Wellington, New Zealand.
JOHN KIRK, M.D., Zanzibar, Africa.
FERDINAND VON MUELLER, M.D., Melbourne, Australia.
JOHN ANDERSON, M.D., Calcutta.
W. H. CAMPBELL, LL.D., Georgetown, Demerara.
T. W. MAWSON, M.B., C.M., Surinam.
GEORGE LAWSON, LL.D., Dalhousie College, Nova Scotia.
R. J. SHUTTLEWORTH, Berne, Switzerland.

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The following name was added to the list of Associates :—

ANDREW T. JAFFRAY, Cinchona Plantations, Darjeeling.

The following Communications were read :—

I. *Further Experiments with Darnel* (Lolium temulentum). By ALEXANDER STEPHEN WILSON.

In addition to the opinions regarding darnel, quoted in a previous paper, the following facts may be mentioned. In 1285, 1 qr. 6 bush. of darnel were sold at Ibstone at 2s. the qr. In 1322, 3 qrs. were sold at Maldon, at the same rate. In 1334, at the same place, 4 qrs. were sold, also at 2s.; and in 1342, at Leatherhead, 2 qrs. were sold at 1s. and 1s. 4d.

Professor Rogers, from whose "History of Agriculture and Prices in England" these figures are taken (vol. ii. "Tables of Rarer Grain"), states in his first volume (p. 222) that he is unable to identify darnel, and that he has "searched in vain in glossaries" for this and other terms, "which," says he, "seems completely to have died out." The term darnel has certainly not died out of glossaries, nor common dictionaries; it has undoubtedly been applied to *Lolium temulentum* from remote mediæval times, and the probability is greater that the "darnel" of the thirteenth and fourteenth centuries was the darnel of the sixteenth, than that it was some other grain. Tusser, writing in the sixteenth century, asks, "Doth darnel good among the flowery wheat?" (A sonnet against a slanderous tongue.) Rogers does not state for what purpose it was used, but the fact that it was sold in such quantities as 3 qrs. and 4 qrs. almost precludes the idea that it was regarded as poisonous. It may have been used as food for poultry, for which purpose, as previously noticed, it was recommended by Columella, and has been used by the present writer.

In other places Tusser calls darnel "cockle." In speaking of Dredge and Barley in November's "Husbandry," he says :—

> "Some useth to winnow, some useth to fan,
> Some useth to cast it as clean as they can.
> For seed go and cast it, for malting not so,
> But get out the cockle and then let it go."

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And in March's "Husbandry" he says:—

> "I speak not of mayweed, of cockle, and such,
> That noyeth the barley so often and much."

Again, in May, he sings:—

> "The brake and the cockle be noisome too much,
> Yet like unto boodle no weed there is such."

In which, while it is clear that Tusser did not like darnel as a weed any more than Virgil had done, nor as a part of his malt, he drops no hint that he thought it absolute poison.

Gerarde, in his chapter "Of Darnell," remarks that, "Among the hurtful weeds darnel is the first." "Seeds easily shaken out and scattered abroad." "Grows in fields among wheat and barley, of the corrupt and bad seed, as Galen saith." And though he further refers to the opinions of Galen and Dioscorides as to the medicinal properties of darnel, not a word is said as to its being poisonous.

Parkinson describes nine species of darnel, and he says:—"If the seed happen into drink it will cause a giddy drunkenness; the meal of darnell is very good to stay gangreenes. . . . . It also cleanseth the skin of all lepryes." He does not say it is poisonous, and it may also be said of wheat and barley, that if their seed happen into drink they will cause a giddy drunkenness.

In Symson's MS. Account of Galloway, of date 1684, quoted in "Caledonia" (iii. 284, 285), it is stated that, "The bere was generally very oatie, that is, mixed with wild oats; and in some districts it was mixed with darnel, which they called *roseager;* that being narcotic, occasioned strangers to find fault with the ale, though it did not much trouble the inhabitants, who thought it no ill ingredient, as it made the drink stronger.

In addition to the more recent opinions quoted in my former paper, mention may be made of those expressed in "The Grasses of Great Britain." Mr Charles Johnson, who writes the text, observes in his introduction (p. 12), that the "deleterious character" of *Lolium temulentum* has been "positively determined;" and, in describing the

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plant, he tells us that "many cases are recorded in medical works of poisoning by darnel. The seeds," he continues, "ground and made into bread, with a small proportion of wheat or other flour, and eaten in this manner repeatedly, produce vomiting, purging attended by giddiness, pain, and swelling of the limbs, and eventually gangrene, and death. A small farmer near Poitiers, in France, died in consequence of persevering in the use of bread so circumstanced; while his wife and servant, who discontinued to eat it after the earlier symptoms, recovered. In some instances people have lost their limbs by subsisting on meal in which any considerable quantity of darnel grain was commingled. About thirty or forty years back, according to Christison, almost the whole of the inmates of the Sheffield Workhouse were attacked with symptoms supposed to be produced by their oatmeal having been accidentally adulterated with *Lolium*. Linnæus states that the seeds mixed with bread-corn produced but little effect unless the bread be eaten hot. . . . . The ultimate effects are, on the broad scale, not very dissimilar to those produced by diseased or ergotised grain."

Dr John Lowe, who read a paper on darnel before this Society, and whose experiments are referred to in "Anne Pratt's Flowering Plants," informs me in a note that his first trials were made with seed of unknown source, obtained from Messrs Lawson. Of these he says—"Beginning with 2-drachm doses infused in boiling water, I took next a half ounce of the seed, drinking the infusion, and masticating and swallowing the seeds. Having obtained some recent seed, grown in the Botanic Garden by Mr M'Nab, I began with smaller doses of 1 drachm, increased to half an ounce, until the seed was all consumed. Not the slightest effect was produced on the pulse or general system, and I therefore concluded either that the effects had been overstated, or that the seed grown in Scotland possessed less noxious properties; the latter being probably the fact."

The darnel crop of the following experiments consisted of about eighty separate plants, the best of them showing from twenty to thirty stems. In consequence of the alarming development of fungi on the spikelets, I pulled

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the whole up before the seeds were dead ripe. About forty of the spikes showed ergotised kernels, specimens of which are herewith submitted. Whether these fungi are genetically connected with ergot may be worth inquiring. They are of two descriptions, and red and white in colour. The red fungoid masses very closely resemble, in consistency and colour, the true ergot in its early stage upon seeds of *Glyceria fluitans;* while the white, which has the appearance of a mould, seems to grow from the spores, exuded in large quantities from the young ergot, and carried down the rachis by dew and rain.

All the spikes affected with clearly developed ergot were set aside. Those affected with the above fungi were also kept by themselves; while the spikes freest of blemish were used for the principal experiment.

When the clean seed had dried naturally upon the stems it was threshed off and ground into meal by a coffee-mill, and cleared of the husk or palea by a fine wire sieve. The meal thus consisted of the body of the kernel and the greater part of the bran or outer coats, along with a small amount of comminuted husk. One thousand grains were baked into an ordinary loaf of wheaten flour, the proportions of the dry meal being 14 per cent. darnel, 86 per cent. wheat. Another thousand grains of darnel meal were also mixed with wheaten flour and made into twenty biscuits, the percentage of darnel meal being twenty-five, and each biscuit containing 50 grains of darnel. The loaf was of a dark brown tinge, not quite so dark as whole wheat meal bread. The biscuits showed the bran and bits of the husks as brown and greenish specks.

On October the 8th I ate one biscuit at breakfast, being 50 grains of darnel; on the 9th, one slice of bread at breakfast, containing 100 grains; on the 10th two slices at breakfast, containing 200 grains; on the 11th, two slices at breakfast, and two biscuits at tea, being 300 grains; on the 12th, two slices of bread at breakfast, two biscuits at dinner, and two biscuits at tea, being 400 grains; on the 13th, two slices of bread at breakfast, two biscuits at dinner, and three at tea, equal to 450 grains; and on the 14th, I finished with one slice of bread at breakfast, two biscuits at dinner, and five biscuits at tea, equal to 500

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grains; thus eating on seven consecutive days 2000 grains of darnel meal.

As Linnæus and others had asserted that little effect was produced by darnel, unless eaten hot, the two slices of the 11th, one slice and two biscuits of the 12th, and five biscuits of the 14th, were eaten as hot as they could be put into the mouth. But indeed the notion of eating bread hot is nearly meaningless; since by the process of mastication all bread arrives in the stomach at nearly the same temperature. In the present case it was carried into the stomach along with scalding hot tea. No effects of any kind have been experienced.

Dr Balfour had mentioned in a note to the writer that the darnel seeds raised in the Botanic Garden were usually eaten by birds. Columella recommended Lolium for poultry. Mr Johnson, already quoted, seeks to strengthen his position in regard to *Lolium temulentum*, by suggesting that "some deleterious property" exists also in rye-grass seeds (*L. perenne*), since granivorous birds, according to his observation, never eat them. The present writer has on several occasions seen patches of newly sown rye-grass seeds eaten up, where uncovered, by domestic fowls. The portion of bran and the ground up husks sifted out of the above darnel meal were mixed with oatmeal; the mixture was readily eaten by a tame magpie and the common poultry. A large quantity of the darnel seeds which were rejected as being covered with fungi were also set down to poultry, and greedily eaten up, one reckless cock and hen in particular setting full crops at defiance. No observable results followed.

The conjecture of Dr Lowe and others that poisonous qualities may not be developed in the darnel grown in Scotland, is based partly on the assumption that darnel is poisonous when grown in other countries, and partly on the analogy of some other plants, the qualities of which are affected apparently by differences of situation. But we must first exhaust the analogies of the grasses. Is pure darnel seed ever poisonous anywhere? We see that anciently it was regarded as possessing the popularly ascribed qualities in the south of Scotland. But the malted seeds of all grasses possess intoxicating qualities.

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Barley is not accounted poisonous because its malt is intoxicating. But has any grass been actually proved to change its character from wholesome to poisonous by change in the place of growth, or constituents of soil?

Have wheat, spelt, rye, barley, and oats altered their chemistry during all their history and all their wanderings? Do the descendants of the wheat and barley which Herodotus admired at Babylon twenty-three centuries ago, poison John Smith to-day, in New South Wales?

In the above experiment the darnel meal was taken in the form and manner in which it would be taken if grown amongst corn and milled and eaten with the meal, and in which its assumed pernicious properties are said to have been experienced. But most of the grasses are liable to be ergotised. This autumn (1873) I have collected many highly ergotised specimens in about fifteen genera. The existence of the disease called ergotism in past times makes it probable that in an undrained country, and in fields full of natural grasses growing amongst the corn crops, the amount of ergot was far greater than at present. The oat-grass, which still defies extermination from corn-fields, is very liable to ergot, and frequently has spurs three-quarters of an inch in length. It is almost an absolute certainty that the darnel growing amongst the old wheat and rye was ergotised to some extent. Is it probable that this ergot was removed before the corn was ground? If it was not removed, then the pernicious effects attributed to darnel were at least partly due, not to its healthy seeds, but to its ergotised seeds. And if the ergotised seeds were an adequate cause of disease, why add another cause? When it is further borne in mind that the old crops were very frequently a maslin of wheat and rye, and that the latter is peculiarly liable to ergot (perhaps from exposing its feathers to flying spores in flowering), the verdict of Not Guilty in favour of healthy darnel seeds is seen to be still more in accordance with the evidence. Does any one condemn healthy rye seeds, because ergotised rye seeds are poisonous? It is not impossible that a protracted diet of darnel meal, containing its bran and part of its husk, as would necessarily be the case, might have certain disarranging effects upon the system; but the same may also be possible

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regarding oatmeal or whole wheat meal. Mice are found to strip off and reject the bran of at least many varieties of wheat in a very complete way, but an article of diet may be detrimental without being poisonous. If the quantity of 2000 grains of darnel eaten in a week be said to be an insufficient test, the question then gets more precise, and becomes, At what quantity do poisonous effects begin to appear? And who has made such experiments as to warrant him in saying that though 2000 grains in a week are harmless, 3000 or any other quantity will prove fatal?

It will be incumbent on those who contend for the poisonous character of healthy darnel seeds, to show that in any alleged case of disease all ergotised seeds had been removed from the grain. Is it a probable thing that the farmer of Poitiers removed the ergot? This story, and some others to a like effect, are wholly destitute of scientific limitations, while Christison's suggestion is entirely unwarranted. Actual experiments cannot be set aside by conjectures, and by assumed analogies. Whoever would maintain the bad name which has been attached to darnel, must rebuild his assertions on experiments, the conditions and surroundings of which are adequately known and set forth.

II. *Remarks on the Old Trees in the Home Park at Hampton Court.* By James M'Nab.

Mr M'Nab had visited Hampton Court in September last, and made measurements of many of the largest trees in the park. Among the limes standing at the extreme end of the south avenue, one measured 12 feet 6 inches in circumference, another 15 feet 6 inches, and another 16 feet, at 3 feet from the ground. These limes average from 110 to 120 feet in height. There are numerous elms of very large size, the measurements of which were given. Many of these are still in a thriving state. He next referred to the dead or dying stumps of great trees in the park. One of these is 22 feet 3 inches in circumference, another 23 feet 6 inches, and another 25 feet 4 inches near base, and 41 feet in circumference at 6 feet from the ground. The last is called the pulpit elm. The stump stands 8 feet

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high and is quite hollow. He thought that something ought to be done to preserve, as long as possible, the largest specimens of both the living and dead trunks. Of late years, he said, ruined palaces, abbeys, and ecclesiastical buildings have been receiving much attention in order to prevent them falling into decay, or being carried away piecemeal for walls and farm buildings. These ruins are now rigidly protected, and sums of money are annually voted for theirpreservation. It would be desirable to see all the old trees in Britain equally well cared for by root feeding and stem protecting, as well as by sheltering from inclement weather the decaying stumps of remarkable specimens.

III. *Miscellaneous Communications.*

1. *Diminution of the Swiss Glaciers.*—Mr J. G. Morrison, in a letter to Professor Balfour, dated Stuttgart, 15th October 1873, says:—"We have had a lovely summer, hardly any rain. What struck me most in Switzerland was the great diminution in the size of the glaciers both in Chamounix and Grindelwald, particularly in the former—at least I noticed it more. They have both retrograded and lowered from what they were thirty-five years ago when I was there. I should say the Mer de Glace is at least 150 feet lower than it was. The source of the Arveiron is at least a quarter of a mile back from where it was in my day; the moraines as well, if my remembrance enables me to judge. I met a man in Geneva who had visited Chamounix for 20 years, almost every year, and he has noticed the great difference even in that time. The formerly well-known glacier of Rosenlaui, which used to be one of the prettiest in Switzerland, is now nothing; it looks as if the world was increasing in heat. Does that arise from the internal heat, or from changes merely on the surface causing increase of temperature? Have you anything anomalous as regards plants now growing where formerly they did not? However, that is not so tangible as the retrogression of the glaciers."

2. Mr W. F. Burnley reported the coning of *Araucaria imbricata* at Ericht Bank, near The Kirn, Argyllshire, this season.

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3. Mr Alexander Morrison presented a parcel of mounted Australian plants to the University Herbarium.

4. Dr Alexander Hunter exhibited a large series of photographs, principally illustrating Indian vegetation. He also gave interesting information regarding the progress of art in Southern India during the last fifteen years, and exhibited some beautiful examples of wood engraving, by the natives attending the School of Arts at Madras.

8th January 1874.—Sir ROBERT CHRISTISON, Bart., President, in the Chair.

The following Candidates were elected—

Resident Fellows.

ROBERT KIRK, Bathgate.
JOHN STEWART, W.S., 4, Albyn Place.

Foreign Honorary Fellow.

Baron FERDINAND VON MUELLER, M.D., Director of the Botanic Garden, Melbourne.

The following Communications were read :—

I. *Obituary Notice of Dr J. L. Stewart.* By Dr CLEGHORN. (See pp. 31–33.)

II. *Note on a Station for* Primula veris *in Coldingham Bay, Berwickshire.* By Sir ROBERT CHRISTISON, Bart.

In the fifth edition of his "British Flora," published in 1842, Sir William J. Hooker, in describing the *Primula veris*, adds, "Very rare in Scotland. Near Edinburgh. Introduced about Glasgow. In Scotland scarcely known."

Either Sir William had missed the Scottish localities where now it abounds, or the plant has spread amazingly since the time when the statement now quoted was written. It is probable that he had not visited those districts in the east of Scotland where the plant is by no means uncommon. At all events, thirteen years before the publication of the fifth edition of the "British Flora," Dr Johnston, in his

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"Flora of Berwick-on-Tweed," which included all Berwickshire, says of the *Primula veris*, "Hab. meadows and deans, common." I understand, too, that it is common enough now on the coasts of Fife and Forfarshire.

Unaware of the latter fact, and acquainted at the time only with the poverty in cowslips assigned to Scotland by Sir William Hooker, my surprise was great when, paying a visit in the second week of last June (1873) to "The Mount," a villa recently built on the high bank which overlooks Coldingham Bay, I beheld below me, on stepping out upon the terrace between the house and the edge of the bank, a great green slope densely covered with fine bunches of cowslips.

Coldingham Bay is, I believe, the only sandy bay of any extent in Berwickshire. At its west point, which consists of high, perpendicular, jagged rocks, stands the fishing village of Coldingham, which must not be confounded with the rural village of that name a full mile inland. The east point consists of low, very ragged rocks, which lead eastward to a succession of high, precipitous cliffs, extending two miles to the little sea town of Eyemouth, broken, however, by several small, narrow ravines. The ground of the bay is a fine, smooth, deep sand, widely exposed at low tide, but nearly covered at high water. The rocky east point of the bay rises landward till it forms a large, dome-shaped grassy mound, which is connected by a narrow neck with the bank which forms the land boundary of the bay, and which curves round westward to meet the precipitous western boundary. This bank is 90 feet perpendicular above high-water mark, and is over 400 yards, or about a quarter of a mile, in length; and its face towards the sea is a smooth, steep, concave slope of deep, fine turf. The whole of this great slope was an uninterrupted sheet of cowslips in full flower, so crowded that there was at least one fine tuft of them on every square foot; and the dome-shaped mound to the east was scarcely less covered with them.

The ground on which the house of "The Mount" is built descends eastward by a steep grassy slope into a narrow ravine formed by a small stream. The west slope of this ravine, under the house, presents also a great abundance

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of cowslips; but on the opposite or east slope these disappear, and their place is taken by the *Primula vulgaris*, or Primrose. A little farther east there is another narrow ravine, on the west slope of which the cowslip reappears, with very few primroses; while on its east slope again reappears the primrose, with only a very few straggling cowslips. I had no opportunity of examining the coast farther east towards Eyemouth. St Abb's Head, which immediately succeeds Coldingham fishing village as one proceeds westward, is destitute of the cowslip everywhere; but Dr Johnston says it occurs in the ravines west of St Abb's.

The only other circumstance worthy of note regarding this interesting cowslip bed at Coldingham Bay is, that the plant, though it grows with great luxuriance and flowers most profusely, is quite destitute of fragrance.

In relation to the possibility of the plant having been introduced into this locality, I may add that "The Mount" is too recent a villa to have been the means of introducing it, and, moreover, up to this time it possesses not an inch of garden ground; that there is a farmhouse with a little dressed ground around it, about 400 yards inland; and that at the angle where the cowslip slope meets the western bank of the bay there is another small villa, with some garden ground, from which the plant, if ever cultivated there, might have strayed. But there are no cowslips on the grassy bank near that villa, and it, too, is an edifice which has been built only a few years. There are no other dwelling-houses near the sloping bank except these three, and the fishing village, which is half a mile from it.

III. *Notes on a Visit to Messrs Dickson & Turnbull's Nurseries, Perth.* By James M'Nab.

The nursery grounds of Messrs Dickson & Turnbull, at Perth, have long been well known to cultivators. They were established in 1766, and from them have emanated many new and useful plants. Amongst flowering plants may be mentioned the first set of double Scotch roses, which were so much in fashion about forty years ago, but which are now, I regret to find, scarcely ever asked for. The original stools of these roses still exist,

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capable of producing many thousand plants should they be required. These roses were admirably adapted for the climate of Scotland, and if they were again taken in hand by our southern friends, and received a little of the attention paid to other garden varieties by hybridisation, a new stock might be procured suitable for this country. The original superb scarlet-flowering thorn was likewise raised in this nursery. Here, also, was the seed-bed of the first Swedish turnips sent to Britain, seeds of which were sent by Linnæus to this firm about 1772, and now this hardy vegetable is spread over all the temperate quarters of the globe. Mr Robert Brown, one of the early partners of the firm (formerly Dickson & Brown), was the first discoverer in Scotland of *Menziesia cærulea*, specimens of which still exist in this establishment, being sub-divisions of the original plants found by Mr Brown on the Sow of Athole, in Perthshire. For many years the bog or dwarf American plants, indeed all kinds requiring peat soil, have been cultivated in this establishment with success, and few nurseries in the kingdom contain a greater variety of these interesting plants. The various species of *Ammyrsine*, *Andromeda*, *Azalea*, *Cassiope*, *Fothergilla*, *Gaultheria*, *Ledum*, *Dabeocia*, *Menziesia*, *Rhodora*, *Vaccinium*, also hardy heaths and dwarf rhododendrons, with numerous others, are cultivated here to an extent not often seen. These plants have not received of late that attention from cultivators which they did in former times; nevertheless, none are more attractive for rock-garden or for ornamental clump cultivation, few even surpassing them in general interest.

IV. *On the Destruction of Seedling Ash-Trees by Frost in Mr P. S. Robertson's Nursery, near Edinburgh, in April* 1873. By Alexander Buchan, F.R.S.E., Secretary of the Scottish Meteorological Society.

Towards evening of 7th April 1873, Mr Robertson, apprehending some risk from frost to a plot of young ash seedlings, which having all appeared above ground within the previous ten days were still in the cotyledon leaf, and consequently in a state subjecting them to risk from even a slight

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degree of frost, took the precaution of spreading an old fishing-net over them. The plot consisted of six beds, 47 yards in length. The net, which was "holed" in several places, covered 2½ of these beds, the remaining 3½ beds being in no way covered or protected. The net was supported at a height of 15 inches along the middle line of each bed, sloping down to a height of 9 inches along the shallow trenches separating the beds. After the net was placed over the beds, a part of it was thrown off from a strip of one of them by some boys in their attempts to catch a bird which had gone under the net.

The night was clear, and almost, but not quite calm, there being what may be described as a steady-going breath of air blowing over the surface of the ground. The protected thermometers at the stations of the Scottish Meteorological Society in the surrounding district fell generally from 33° to 36°, but the exposed thermometers indicated several degrees of frost. The frost which did occur was comparatively slight, and only a few of the more tender plants were affected by it, the extent of the injury amounting generally to little more than a slight browning of the leaves.

This was the amount of the damage sustained by the young ash plants growing in that part of the plot consisting of 3½ beds, which was not covered by the net; whereas over those portions protected by the net the plants were all but totally destroyed. Over the narrow strip of one of the beds from which the net had been thrown off in pursuit of the bird, the plants were scarcely, if at all injured. In different parts of the beds over which the net had been spread, there occurred at irregular intervals small patches where the plants were injured to a much less extent. Though attention was not directed to the matter before the net was removed, it is highly probable, from the distribution of these uninjured patches in the beds and the holes of the net, that the former were directly under the latter. Finally, the destruction was most complete along the edges of the shallow trenches separating the beds; in other words, over the parts of the beds *nearest* to which the net was suspended.

Some time after the young plants had been killed to the ground, many seeds which would otherwise have lain dor-

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ment sprang up, thus partially making up for the loss sustained. The loss, however, is considerable, the extent of it being represented by the fact that only about 400 plants per square yard are now growing in those parts of the beds in which the destruction of the seedlings took place; whereas, elsewhere in the beds, the number is 2000 to the square yard.

The explanation of these facts is this. The plot where the young seedlings grew is flat, situated on the top of the ridge immediately to east of Fettes College, and perfectly open to the horizon all round, there being no trees, houses, walls, or other obstructions rising up on any side that could impede in any appreciable degree the cooling of the earth's surface by terrestrial radiation. Consequently the cooling of the ground, and all objects close to it, went on unchecked, and against this cooling process—viz., by the radiation of heat from the ground toward the free sky—the thin covering afforded by the meshes of the net was too slight and flimsy to be of much avail.

The effects of terrestrial radiation are at the maximum when the air is calm and very dry, and its temperature rather low. Of this, the great frost of Christmas 1860 was, as respects the effect on vegetation, a terrible example. If, however, the cold air produced through the influence of terrestrial radiation be allowed to accumulate close to the ground, no small amount of damage may be done by a comparatively slight frost. On sloping ground such accumulations of cold air cannot go on, because cold air being heavier than air which is warmer, as soon as the air in immediate contact with sloping ground is cooled, it flows down to a lower level, just as water would do, and its place is taken by the warmer stratum of air immediately over the downward-flowing cold current of air. In this way a higher night temperature is maintained in situations where the ground slopes down to lower levels, and accordingly such situations should be chosen for those plants which, at any stage of their growth, are peculiarly liable to be injured by frost.

If the air be not calm, but a wind—even a slight wind—be blowing, the different layers of air are thereby mixed; and thus the air cooled by contact with the cold ground is

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not suffered to rest on the ground, but is mixed with the air above it, and the temperature is thus prevented from falling so low as it otherwise would.

Now, the plot of ground at the nursery is, as has been said, flat, consequently the cold air could not flow away from it. Within the plot itself, however, there would be a tendency of the cold air to flow into the shallow trenches between the beds, and settle there.

The steady-blowing light wind was sufficient to disturb the air cooled by contact with the ground, and mix it with the stratum of air lying immediately over it, in all places where the wind was felt. Over the beds unprotected by the net the wind passed freely and unchecked; and there, consequently, the temperature did not fall lower than was just sufficient to brown, without destroying, the young seedlings. But to the bed protected by the net the wind had no access owing to the intervention of the net; and there, consequently, the air strata not mixing, the temperature fell so much lower than over the beds adjoining as to destroy the seedlings, which happened at the time to be just at that stage of their growth when they are most susceptible of injury.

This statement regarding the resistance offered to the wind by such an object as the meshes of an ordinary fishing-net, refers to a peculiarity of the wind which, not being generally recognised, may be here further illustrated.

A fence made of slabs of wood, 3 inches in width and 3 inches apart from each other, is a protection even during high winds to objects on the lee side of it. In this case the fence does not admit of a free passage to the wind through interstices so wide.

On the 29th April 1869, a very dry west wind broke over Scotland, and completely destroyed all young shoots in situations which exposed them to its force; but young shoots not exposed to the force of this withering blast escaped. A few days thereafter I happened to be in the west of Scotland, where its influence was most felt, and the appearance presented by trees and shrubs was of a very remarkable character, the leaves on the west sides and tops of the trees being completely destroyed, that part of the tree in many cases appearing as if it had been steeped

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in tar, while the rest of the tree was uninjured and in full leaf. A closer inspection gave abundant proof of the fact that the flimsiest protection to windward, such as a few bare twigs, preserved the tenderest leaves from the scorching influence of this wind; branches in such situations were seen fully clad in their spring foliage. And since the damage done was in proportion to the strength of this dry wind as it passed over each object, it was seen that a few bare twigs presented an obstruction to the wind so effectual as to produce a calm, or all but a calm, on the lee side.

A wire screen, with meshes an inch and a half apart, is known to afford a protection during high wind to flower-pots placed on its lee side; and Mr Adie of Rockville, near Linlithgow, informs me that such a wire screen, supported at intervals by strong iron rods, was there blown down, along with the iron rods, from a vertical to a horizontal position, during a heavy gale of wind—an incident which shows in an impressive manner the strong resistance offered by a light wire screen to the onward course of the wind.

From these illustrations it will be evident that the air enclosed under the net which was spread over the ash seedlings was practically still, and the cold produced by radiation was thus allowed to accumulate close to the surface over the seedling plants.

Thus, then, the destruction of the young ash plants was due to the net being of too flimsy a texture to offer a sufficient obstruction to terrestrial radiation, whilst at the same time it afforded a complete obstruction to the wind, and thus prevented a circulation of air around the young plants—the destruction, be it observed, being most complete on the borders of the trenches in which the coldest air settled, and over which the stratum of air imprisoned under the net was least in thickness.

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V. *Notice of Botanical Excursions in* 1873. By Professor Balfour.

A visit was made on the 15th May to the sandstone quarry of Craigleith, for the purpose of seeing the fine specimens of fossil trees which had been recently exposed by the workmen. We were enabled to see the largest specimen to great advantage, and observe the angle at which it was inclined, to measure its size, and to observe certain phenomena connected with its fossilisation. The other trunk showed a difference in the mode of its inhumation in the sandstone. It was an entire trunk, and its structure was not so hard as the former. The large specimen has, through the kind exertions of Sir Robert Christison, been transferred to the British Museum; while a portion of the smaller one, 9 feet in girth, has been sent to the Edinburgh Botanic Garden, and a section of it has been made for preservation in our Botanical Museum as well as in the British Museum. The section made by Mr M'Glashan has been polished, so as to exhibit the appearance presented by the vessels of the wood; here and there a dim outline of circles is seen, but the greater part of the tissue is obscured by the infiltration of carbonate of lime and by pressure. The structure, however, is well seen under the microscope. These trees have been fully described by Sir Robert Christison (Proc. Roy. Soc. Edin. vol. viii. p. 104). There is in the Botanic Garden the trunk of a fossil tree discovered in the same quarry in 1830, and described by Mr Witham in 1831, and we expect to get this supplemented through the kindness of Mr Archer, who has another portion of the same tree in the Museum of Science and Art in Edinburgh.

In an early excursion in spring, Mr Sadler gathered specimens of *Equisetum umbrosum* in fructification on the banks of the Esk, near Penicuik House, where it had previously been noticed. The plant is by no means rare in Scotland, but it is seldom gathered in good fructification, because of the early period of the year at which it sends up its spikes.

Excursions in May to Roslin, Kinghorn, and Queensferry—in June to Drem, Currie, St Boswells, Melrose, and

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Clackmannan, and in July to Lindores Loch, did not add much to our knowledge of the flora of these districts.

Lathræa squamaria was found abundantly in Roslin woods. *Vicia lutea* was observed in flower at North Queensferry, indicating that the station has not yet been destroyed by the blasting operations which are now injuring the whole extent of the fine cliffs in that quarter.

Allium Schœnoprasum was seen as formerly on the rocky shore near Inverkeithing. Blasting operations are also causing much havoc on the trap-rocks at the western side of North Queensferry, and ere long we may expect that such plants as *Astragalus glycyphyllus*, *Thalictrum majus*, *Spiræa Filipendula*, and others, will disappear from that locality.

Specularia hybrida was seen in considerable quantity near Gullan.

In the neighbourhood of Currie and Colinton the shales yielded good specimens of *Lepidodendron gracile*, and other species, as well as specimens of *Sigillaria* and *Stigmaria*, and of *Adiantites Lindsœformis*, the last in the station indicated by Professor Geikie.

Between St Boswells and Melrose the following plants were noted:—*Ranunculus floribundus*, *Aquilegia vulgaris*, *Clematis Vitalba*, *Nasturtium sylvaticum*, *Draba muralis*, *Hypericum humifusum*, *Saxifraga umbrosa*, *Viburnum Opulus*, and *Lonicera Caprifolium*. During this Saturday's excursion 175 species were collected, of which 144 were named and laid out for study in the class-room at the Botanic Garden on Monday morning at eight o'clock.

The district of Clackmannan had not been previously visited by our party. The day, however, was very unfavourable, and our botanising was much hindered. Among the plants of interest gathered were *Epilobium angustifolium*, *Sempervivum tectorum*, *Vaccinium Oxycoccus*, *Habenaria chlorantha*, *Listera ovata*, *Orchis incarnata*, and *Lastrea spinulosa*. A visit was made to the rocks below Stirling Castle, and the following plants were collected:—*Verbascum Lychnitis*, *Sedum album*, *S. reflexum*, *Lactuca virosa*, *Smyrnium Olusatrum*, and *Petroselinum sativum*.

The Lindores excursion yielded *Nuphar luteum*, *Veronica scutellata*, *Typha angustifolia*, *Bidens cernua*, *Potamogeton*

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plantagineus; and on the trap rocks of Mare's Craig, near Newburgh, were collected *Dianthus deltoides, Potentilla argentea, Sagina subulata, Geranium columbinum, Sedum reflexum,* and *Anthemis arvensis.* On the ruins of Lindores Abbey were seen *Verbascum Lychnitis, V. Thapsus, Malva moschata, Scrophularia vernalis, Vinca minor,* and *Sedum album.*

On 12th July we visited the Red Sandstone cliffs between Arbroath and Auchmithie. Mr James Scrymgeour from Dundee, and Mr Andrew Wilson of Arbroath, met the party. The cliffs are productive, and the vegetation very luxuriant. Among the plants gathered may be noticed: — *Geranium sanguineum, Campanula glomerata,* beautifully in flower; *Astragalus glycyphyllus, Habenaria viridis, Fumaria micrantha, Trifolium hybridum, Vicia sylvatica, Conium maculatum,* very luxuriant; *Gentiana campestris, Eupatorium cannabinum,* and *Scolopendrium vulgare.*

From the 17th to the 19th July a combined excursion of botanists, zoologists, and geologists was made to the island of Arran. The party consisted of Professors Carus, Geikie, and Balfour; Professor M'Nab of Dublin, Dr Stirling, Mr Ellis, Mr Sadler, and upwards of fifty students.

The botanists were accommodated at the Douglas Hotel, Invercloy, and most of the zoologists at Lamlash.

The party at the Douglas Hotel, numbering about fifty, proceeded to the Corriegills' shore, and gathered some good plants, such as *Anagallis tenella, Samolus Valerandi, Erythræa linariifolia, Calamintha Clinopodium,* and *Hypericum Androsæmum.*

The party was divided into three companies. Some proceeded to Lamlash to join Professor Carus in dredging; some accompanied Professor Geikie to examine the geology in the neighbourhood of Glen Sannox, and the others botanised on the coast between Brodick and Corrie. In Brodick Bay were collected *Mertensia maritima, Brassica monensis, Salsola Kali, Jasione montana,* &c. On the shore towards Corrie were picked *Œnanthe Lachenalii, Lycopus europœus, Juncus maritimus, Schœnus nigricans,* and *Scirpus maritimus.* On the carboniferous sandstone rocks in the woods were collected *Hymenophyllum Wilsoni, H.*

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Tunbridgense, *Lastrea æmula*, *Asplenium marinum*, and *Scolopendrium vulgare*.

The morning of Saturday 19th July was unpromising, thick mist being on all the hills. About nine o'clock the botanical party started to ascend Goatfell. On their way they were able to note the stages of ascent by *Pteris aquilina*, extending to about 700 feet, *Erica Tetralix*, to about 1350, and after that by *Saxifraga stellaris*, *Alchemilla alpina*, and *Salix herbacea*—the latter at 2100 feet. The shrubby region was marked by heather, heaths, and *Myrica Gale*. It rained heavily, and the mist was so dense that the party had to take their bearings by the compass.

Dr Stirling gives the following report on the results of the zoological excursion:—

"On Friday morning, July 18th, a party of twenty-four, under the superintendence of Professor Carus, started dredging operations in Lamlash Bay. The company was divided into three divisions, under Professor Carus, Mr Barclay, and Dr Stirling.

The weather on the whole was very favourable for dredging operations within the bay and round Holy Island, but outside the bay it was not considered safe to run the risk of losing the dredge. The wind was rather too strong for using the towing net, and this accounts for the absence of medusoid oceanic forms in this report. A small dredging party ventured out on Saturday morning, while the remainder were contented to examine the shore at low water.

Amongst Sponges, the genera *Halichondria* and *Cliona* were found, the latter easily recognised from its habit of boring into cast-off shells. The only *Hydrozoon* was the single genus *Hydractinia*. As representatives of the *Actinozoa* were the *Anthea*, a sea-anemone differing from the others in its not being able to retract its long finger-like tentacles upon irritation. Many representatives of the *Adamsia* were obtained. This genus offers an example of what Van Beneden has named "Commensalism." This *Adamsia* is always found to coat the shell containing the hermit-crab. The hermit-crab and its shell may be often found without the *Adamsia*, but the *A.* never unless in connection with the shell of the hermit-crab. These two animals seem to live together for their common weal, just

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the same arrangement as is seen in the glass-rope Sponge of Japan (*Hyalonema*), with its encrusting Zoantharian.

We were fortunate in obtaining many fine specimens of *Echinodermata*, which seem to be specially well represented over the ground where we dredged. Twice were we successful in obtaining half a dredge full of the exceedingly pretty rosy tinted *Comatula rosea* (Forbes). It is rather unfortunate that the colour on these animals cannot be preserved in spirits. Through the kindness of Mr Barclay, we had an opportunity of examining the young stage of this genus (formerly described as a distinct genus under the name of *Pentacrinus europœus*), which is stalked and fixed, while the adult form has no stalk, and can move from place to place.

The Ophiurids were specially abundant, including *Ophiura tenturata* (Forbes), *Ophiocoma bellis*, *O. neglecta*, and *O. rosula*.

The *Asteroidea* were also plentiful; *Uraster rubens*, *Solaster papposa*, *Goniaster equestris*, *Cribella rosea*, and the famous *Luidia fragilissima*, only a single specimen of which was found; and it afforded a good example of the reason why it receives the specific name *fragilissima*, for before it could be removed from the dredge it broke off two of its arms, and it was only by handling it with the greatest care that it was preserved in a very fair condition. It had the characteristic red brick colour, and seven rays.

The regular Urchins were represented by several specimens of *Echinus sphœra* and *E. miliaris*. The irregular forms by *Spatangus purpureus* and *Brissus lyrifer*, with its fiddle-shaped dorsal impression.

The *Vermes* (Worms) were pretty generally represented by the genera *Nereis*, *Polynoe*, *Nemertes*, *Serpula tubularia*, *S. contortuplicata*, *Spirorbis communis*, and *Phyllodoce viridis*.

The *Crustacea* were tolerably abundant in quantity, but chiefly of the common genera. *Portunus*, *Gammarus*, *Carcinus*, *Caprella*, *Talitrus*, and *Pagurus*, which was specially abundant; and the genus *Inachus*, which has the remarkable habit of nipping off with its pincers small parts of the sea-weed near it, and sticking these all over its back and appendages, so that it is scarcely possible to distinguish it

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from a mass of floating sea-weed when so coated. When it has worn these adornments for a sufficient length of time, it sets to and takes them all off again, and then bedecks itself anew. For this latter fact we are indebted to Mr Robertson of Glasgow. It uses for this purpose both the *Ulva* and the *Phyllophora rubens.*

Molluscoidea.—The *Ascidians* were represented by the single genus *Ascidia*, three or four specimens of which were taken on the Saturday excursion.

The *Polyzoa.*— The genera *Tubulipora*, *Crisia*, *Salicornaria*, *Lepralia*, and *Membranipora*, which was specially abundant, occurring in circular patches on the expanded fronds of the common tangle.

The *Mollusca proper* were moderately well represented. The *Bivalves* by a large species of *Pecten*, *P. opercularis*, *Anomia ephippium*, *Solen ensis*, and *Lima hians*, the latter being found in considerable abundance. Its nest also was found, and for the most part consisted of the beautiful red weed, *Phyllophora rubens*, or sometimes this in combination with the branched roots of the tangle (*Laminaria*). In the roots of the tangle also several species of worms were found creeping.

Gasteropoda.—*Patella*, very large specimens, *Trochus*, *Littorina*, and *Chiton ;* the *Nudibranchiata* by the two genera *Doris* (Sea-lemon) and *Eolis ;* the latter is specially beautiful, with the highly-coloured tufts on its back. These tufts are prolongations of the intestine, and their bright colour is due to cells, containing colouring matter, lining them, which in all probability secrete bile."

Professor Geikie gives the following notes on the geological work :—

" On the first evening an examination was made of the remarkable lower carboniferous breccias on the shore near Invercloy, and evidence was collected bearing on their probable glacial origin. The well-known basalt-dykes of that coast-line were likewise examined, especially with reference to their influence on the surrounding rocks, and their varying modes of weathering.

Friday was devoted to an examination of the relations of the Old Red Sandstone and carboniferous strata between Brodick Bay and the North Sannox Water. Traces of a

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great fault were found by which the carboniferous rocks are separated from the Old Red Sandstone—a fault which in that part of the island, at least, prevents the usual unconformability between the two formations from being seen. The common idea that there is a gradual passage along the east of Arran, from the carboniferous into the Old Red Sandstone was found to be quite erroneous. Special attention was given again to the character of the breccias, and some curious indications of their ice-borne origin were obtained to the north of Glen Sannox. Evidences of contemporaneous volcanic activity in a low part of the carboniferous series occurred in the form of a thick bed of amygdaloidal melaphyre, with coarse volcanic agglomerate seen on the shore some way north from the thick marine limestone of Corrie—perhaps, the earliest indication of volcanic action in Arran.

On Saturday morning the party ascended the stream to the south of the White Water, and found a fine section there of red well-bedded trap-tuff underlying a thick coulée of porphyrite, and interstratified among the carboniferous red sandstone of the district. This volcanic intercalation could be traced for fully half a mile up the hill towards the granite, but before reaching the latter rock its further course is completely hidden under the immense moraine heaps and boulders which descend from the corrie under Goatfell to the shore. It seemed open to question whether there is really any Old Red Sandstone there between the carboniferous area and the granite. If there is not, then it would follow that the main mass of the Arran granite cuts off and alters carboniferous strata. The inclemency of the weather prevented a further examination of this point, as well as of the sections on Maoldon."

On 26th July a party of thirty visited Dumfries, and examined the left bank of the Nith between Glencaple and Caerlaverock. In the salt marshes were collected *Sucæda maritima*, *Salicornia herbacea*, *Samolus Valerandi*, *Blysmus rufus*, and *Carex extensa*. In salt pools Mr G. G. Balfour found *Ruppia maritima* var. *rostellata* and *Zannichellia pedicellata;* and Professor M'Nab discovered *Statice bahusiensis* on the shore. Near Caerlaverock Castle were gathered *Œnanthe fistulosa* and *Hypericum maculatum.*

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On 30th July a visit was made by Professor Balfour and Mr Sadler to the Bass Rock, in company with several members of the Berwickshire Naturalists' Club. The Tree Mallow (*Lavatera arborea*) was gathered in fine flower, and also *Beta maritima.* Two species of flowering plants not hitherto recorded from the Bass were collected, viz., *Sagina procumbens* and *Peplis Portula.*

An excursion to Killin was undertaken on 5th August. At one o'clock the party started for Cham-a-creag. The day was dull and rather cold. Among the plants collected were —*Thalictrum alpinum, Cochlearia grœnlandica, Sagina subulata, Cherleria sedoides, Cerastium alpinum, Sibbaldia procumbens, Potentilla maculata, Dryas octopetala, Saxifraga nivalis, Saussurea alpina, Azalea procumbens, Gentiana nivalis, Veronica saxatilis, Armeria maritima, Salix herbacea, S. reticulata, Tofieldia palustris, Sesleria cœrulea, Polystichum Lonchitis,* and *Botrychium Lunaria.*

Next morning the whole party, consisting of Professors Balfour and Dickson, Drs T. A. G. Balfour, C. Stuart, W. Craig, Messrs W. Carruthers, A. Gibson, I. B. Balfour, G. G. Balfour, W. Macfarlane, and J. Sadler, started at 9 A.M. in a two-horse drag for Benmore. They stopped at the foot of the hill, and ascended by the valley on the east side, and visited Bheinean or Stobinean, a mountain 3827 feet in height, returning in the evening about 7.30. The day was fine, but the wind was very high. Among the plants gathered were the following:—*Thalictrum alpinum, Draba rupestris, Cerastium latifolium, Cherleria sedoides, Sibbaldia procumbens, Epilobium alpinum, E. angustifolium, Saxifraga nivalis,* very large, *Carex pulla, C. Persoonii, Allosorus crispus, Polypodium alpestre,* and *Hymenophyllum Wilsoni.* On the summit of Bheinean were gathered *Sibbaldia procumbens, Gnaphalium supinum, Carex rigida, Saxifraga stellaris, Festuca ovina* var. *vivipara, Salix herbacea* in fruit, and *Luzula spicata.*

On 7th August the party visited the grounds of Finlarig, and measured several of the old trees there. A full-grown sycamore measured in circumference 15 feet 2 inches, at 4 feet from the ground; a branch on it had been bent downwards in early growth and become grafted into the main trunk. *Staphylea pinnata* was seen in fruit, also *Campanula latifolia* and *Ribes alpinum.*

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VI. *Report on the Open-Air Vegetation at the Royal Botanic Garden.* By James M'Nab.

The past month, like December 1872, has been comparatively mild. Only on nine mornings did the thermometer fall below the freezing point—the lowest being on the 7th, 11th, 12th, 24th, 27th, and 28th, falling respectively to 27°, 28°, 27°, 28°, 29°, and 26°; on eight mornings between the freezing point and 40°, and on fourteen mornings above 40°, the highest being on the 2d, 3d, 5th, 8th, 9th, and 26th, standing at 44°, 44°, 45°, 45°, 45°, and 46°. During the corresponding month for 1872 the thermometer was also nine times below the freezing point, the lowest being on the 5th, indicating 20°; eighteen times between the freezing point and 40°, and four times above 40°, the highest being on the morning of the 23d, indicating 49°.

The comparatively high night temperature during December 1873 has been the means of keeping many open-air plants in bloom for a long period, besides greatly forwarding others. On the first day of January 1874, flowers of 138 species were collected in the Botanic Garden. Of these about 35 may be considered as autumn and spring plants, and the remaining 103 as summer and winter plants still flowering. Only two species of spring flowering bulbs are in bloom, viz., *Leucojum vernum* and *Scilla sibirica*, accounted for by the bulbs being near the surface of the ground. One plant of the *Orobus vernus* is in flower on a warm border.

In December 1863, 245 species of open-air plants were picked in the Botanic Garden between the 1st and 31st of that month, and catalogued in the "Proceedings of the Royal Society" for January 1864 (vol. v. p. 166). The list contains ten more species of true spring plants than were picked on the 1st of January this year. The month of December 1863 was very mild, sweet peas and Hepaticas flowering together. It may be stated that many of the plants in bloom during the early part of December 1873 are long past.

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VII. *Localities for some Species of British Fungi recently collected by* Professor ALEX. DICKSON and J. SADLER.

Agaricus velutipes, Royal Botanic Garden.
Hygrophorus ceraceus, summit of Ben Lawers, Perthshire.
Polyporus alligatus, Royal Botanic Garden.
igniarius, beech tree, Arniston.
hispidus, Meggetland and Corstorphine, ash trees.
terrestris, Polton.
betulinus, Killin.
Daedalea unicolor, Corstorphine, Royal Botanic Garden.
Thelephora mollissima, Arniston.
laciniata, Nidpath, near Peebles.
Stereum hirsutum, oak trees, Arniston.
Clavaria cristata, Arniston.
abietina, Arniston.
amethystina, Finlarig, Killin.
Calocera viscosa, Arniston.
Tremella foliacea, Roslin.
mesenterica, Roslin.
Hydnangium carneum, Glasgow Botanic Garden.
Octaviana asterosperma, under *Eucalypti*, Glasgow Botanic Garden.
Hymenogaster tener, Glasgow Botanic Garden.
Lycoperdon gemmatum, Arniston.
pyriforme, Roslin.
Didymium squamulosum, in hollow stems of *Heracleum giganteum*, Royal Botanic Garden.
Stemonitis fusca, Killin, Royal Botanic Garden.
Cystopus candidus, on shepherd's purse, Davidson's Mains, &c.
Spathularia flavida, Killin.
Peziza aurantia, quadrangle, Glasgow University.
Bulgaria inquinans, oak trunks, Arniston.
Xylaria hypoxylon, Arniston.
Isaria arachnophila, Dunkeld.
Ustilago urceolorum, on *Carex rigida*, Canlochan and Loch Chandor.
Trichia chrysosperma, Colinton Woods.

Specimens of the Fungi were exhibited; and the authors expressed their obligations to Mr M. C. Cooke for assisting them in naming the more critical species.

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VIII. *Miscellaneous Communications.*

1. *Fruiting of Stangeria.*—Dr Paterson, Bridge of Allan, presented to the Museum at the Botanic Garden a female cone of *Stangeria paradoxa* (Bot. Mag. t. 5121), recently produced in his hothouse. Professor Balfour remarked that the plants in the Botanic Garden had produced male cones.

2. *Fruits of Amomum.*—Mr Roy, Glasgow, presented to the Museum fruits of two species of Amomum from Old Calabar, where they grow in great abundance, and are used as spices by the natives. Professor Balfour stated that he had examined the fruits, and so far as he could make out, the small-seeded one was *A. angustifolium* of Sonnerat, and the other with larger seeds *A. sceptrum* of Oliver and Hanbury. The former is very pungent, while the latter is nearly flavourless.

3. *Roots on trunk of Beech.*—Mr Baxter, Daldowie Gardens, exhibited a mass of roots developed on the trunk of an old beech tree. Some years ago a portion of the beech had been accidentally knocked off, leaving a scar about 2 feet long, and 18 inches wide, at 8 feet from the ground. The wound was eventually covered by new bark. On the removal of this new bark last year, it was found that the mass of roots exhibited had been developed from the upper edge of the wound, and become united with the bark at lower edge. The roots were about 3 feet long.

4. Sir Robert Christison, Bart., exhibited and presented specimens of *Gastrolobium grandiflorum*, a N.E. Australian plant, which is poisonous to cattle. He had received the specimens from his cousin in Australia, accompanied with the following note:—"The plant affects all stock alike. I once saw a bullock of mine die of it. He ate it in the morning, was yoked up in the team, and died in great agony about 2 P.M. Cattle generally take death quietly, but this one roared terrifically, and died in convulsions, his eyes bloodshot, and apparently suffered acute pain."

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12th February 1874.—Sir Robert Christison, Bart., President, in the Chair.

The following Candidates were elected Resident Fellows:—

William Caldwell Crawford.
Andrew Moffat.

The following Communications were read:—

I. *On a Diatomaceous Deposit in the district of Cromar, Aberdeenshire.* By Rev. G. Davidson. Communicated by Professor Dickie.

Navicula hebes or obtusa.
sphærophora.
amphirhynchus.
firma.
ovalis.
cuspidata.
gibberula.
lævissima.
Semen.
Bacillum.
Pinnularia nobilis.
major.
viridis.
cardinalis.
interrupta.
oblonga.
gracillima.
hemiptera.
var. β, stauroneiformis
acuta.
radiosa.
mesolepta.
Stauroneis Phœnicenteron.
anceps.
gracilis.
punctata.
Epithemia turgida.
sorex.
proboscidea.
ocellata.
Epithemia granulata.
Zebra.
alpestris.
Argus.
gibba.
rupestris.
species (?)
Orthosira arenaria.
spinosa.
Melosira nivalis.
Pleurosigma attenuatum.
Encyonema cæspitosum.
Denticula obtusa.
Cymbella Ehrenbergii.
cuspidata.
Helvetica. } rare.
Scotica. }
maculata.
Nitschia sigmoidea.
vivax (rare).
Himantidium gracile.
bidens.
Arcus.
pectinale.
Cocconema lanceolatum.
cymbiforme.
Cistula.
cornutum.
Synedra capitata.
biceps.

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Synedra Fibula.	Gomphonema constrictum.
radians.	dichotomum.
Ulna.	subtile.
Mastogloia Smithii.	Vibrio.
Cocconeis Placentula.	elongatum.
Thwaitesii.	Amphora ovalis.
Cyclotella antiqua.	Cymatopleura Solea.
Rotula.	elliptica.
operculata.	Surirella splendida (rare).
Kutzingiana.	Tabellaria fenestrata.
Gomphonema acuminatum, β, γ, &c.	flocculosa.
	Odontidium Harrisonii (rare).
intricatum.	mutabile.
&c.	&c.

II. *Botanical Excursions in the Neighbourhood of the Baths of Lucca during the Summer of* 1873. By John F. Duthie.

During my stay last summer at La Villa, in the valley of the Lima, I carefully made a note of all the plants I came across in my walks and excursions in the neighbourhood, and I hope in this paper to be able to give some account of them; but first I will briefly describe some of the chief features of the country.

The principal river of this part of Tuscany is the Serchio, which descends from the Apennines to the west of Monte Pellegrino, and flows through the rich district called the Garfagnana, receiving in its course several torrents from the Apennines of Barga and Coreglia, and on the opposite side of the valley from the Apuan Alps; it is afterwards joined by its largest tributary, the Lima, about a mile below the village of Ponte a Serraglio, the capital so to speak, of the "Baths of Lucca" commune.

The Lima rises on a mountain called the "Libro Aperto," one of the Pistoia Apennines. At first threading its way by the magnificent pine-woods of Boscolungo, it rapidly descends to the chestnut region in the neighbourhood of San Marcello; then, after winding for several miles by wooded hills and limestone cliffs, it passes by the villages of La Villa and Ponte a Serraglio, and joins the Serchio, as I have said, about a mile below the latter place. There is a considerable number of smaller streams forming

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lateral valleys, whose intervening hills, extending in long narrow ridges, descend more or less abruptly on reaching the main valley below.

The mountainous nature of the country and the abundance of trees, combine to produce a rich and varied flora. Professor Caruel, in his "Statistica Botanica della Toscana," divides the flora of Tuscany into five botanical regions or zones of vegetation, viz.:—1, *Maremmana*, corresponding with the coast-line; 2, *Campestre*, from thence to the base of the mountains; 3, *Submontana*, the chestnut region, from the base of the mountains to the lower limits of the beech; 4, *Montana*, the region of the beech; 5, *Alpestre*, the bare summits.

The principal products of cultivation are the chestnut, the vine, the olive, Indian corn, and hemp. The chestnut trees cover more or less the hills in the neighbourhood of the baths up to the height of 3000 feet. The harvest commences in October, and the supply is generally sufficient for exportation. The nuts are sent to mills, where they are ground to a fine flour; this is generally made into flat cakes called "necci," like scones, which are cooked between hot stones; these, with Indian corn (granturco) in the form of polenta, are what the inhabitants here mainly live upon. The vine is plentiful, but it produces an inferior wine, as they do not take sufficient care in the process. The olive reaches its northern limit in this district, and in consequence the supply is variable, though the quality is generally superior. Hemp is much grown in the valleys; it is gathered and prepared in August, and sent to market in September. The country people use it a great deal for making coarse sheets and cloths, and for their own clothing.

In order to give a general idea of the richness of the indigenous flora, I will mention the names of some of the more interesting species which I found in a few of the best localities I have visited. First will come those of the Lima valley, where I have collected perhaps the greater part of my "Bagni di Lucca" plants; then will follow some collected in the valley of the Serchio; on the Pratofiorito; and a few from the Monti Pizzorne; after which will be given accounts of some excursions made to

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some of the higher parts of the mountains, with remarks on the plants collected.

In the immediate neighbourhood of La Villa I would mention more particularly the following:—

Clematis recta.
flammula.
Ranunculus acris.
lanuginosus.
nemorosus.
velutinus.
Aquilegia vulgaris.
Arabis Turrita.
Draba muralis.
Lepidium graminifolium.
Reseda luteola.
Cistus salvifolius.
Helianthemum guttatum.
Dianthus monspessulanus.
Seguierii.
liburnicus.
Carthusianorum.
Armeria prolifer.
velutinus.
Saponaria officinalis.
Alsine tenuifolia, var. laxa.
Mœrhingia muscosa.
Stellaria uliginosa.
Cerastium campanulatum.
Herniaria hirsuta.
Polycarpon tetraphyllum.
Radiola linoides.
Linum gallicum.
Althæa hirsuta.
Hypericum montanum.
Geranium nodosum.
rotundifolium.
Ononis spinosa.
Genista pilosa.
germanica.
Cytisus triflorus.
Melilotus alba.
Trifolium angustifolium.
glomeratum.
Dorycnium herbaceum.
rectum.
Lotus hispidus.
Lotus angustissimus.
Astragalus glyciphyllos.
monspessulanus.
Vicia dasycarpa.
bithynica var. angustifolia.
Ervum gracile.
Potentilla recta.
obscura.
Epilobium rosmarinifolium.
Œnothera biennis.
Callitriche stagnalis.
Lythrum hyssopifolium.
Salicaria.
Sedum stellatum.
cepæa.
rubens.
dasyphyllum.
rupestre.
Pimpinella peregrina.
Œnanthe pimpinelloides.
Fœniculum officinale.
Tordylium maximum.
Orlaya grandiflora.
Physospermum aquilegifolium.
Sambucus Ebulus.
Lonicera etrusca.
Galium parisiense.
var. lejocarpum.
purpureum.
Centranthus ruber.
Knautia hybrida.
Pulicaria dysenterica.
Bidens tripartita.
Anthemis Triumfetti.
Achillea ligustica.
Chrysanthemum Myconis.
Artemisia camphorata.
Helichrysum angustifolium.
Filago gallica.
Senecio erraticus.
Echinops sphærocephalus.
Carlina subacaulis.

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Centaurea transalpina.
maculosa.
Scolymus hispanicus.
Tolpis umbellata.
virgata.
Hypochæris glabra.
Seriola ætnensis.
Urospermum Dalechampii.
picroides.
Picris hieracioides.
Picridium vulgare.
Chondrilla juncea.
Zacintha verrucosa.
Crepis fœtida.
taraxacoides.
leontodontoides.
neglecta.
vesicaria.
Hieracium subaudum.
crinitum.
prenanthoides.
prælatum.
Andryala sinuata.
Campanula Medium.
erinus.
Erica arborea.
Calluna vulgaris.
Hypopitys multiflora.
Cyclamen neapolitanum.
Lysimachia punctata.
Erythræa maritima.
Convolvulus Cantabrica.
Heliotropium europæum.
Omphalodes verna.
Verbascum Blattaria.
Lychnitis.
floccosum.
Linaria græca.
pellisseriana.
Scrophularia canina.
Digitalis lutea.
Veronica urticifolia.
Euphrasia lutea.
Orobanche major.
Lycopus europæus.
Satureia montana.
Micromeria Juliana.
Calamintha Nepeta.
Salvia glutinosa.
Scutellaria Columnæ.
Melittis melissophyllum.
Stachys germanica.
recta.
Teucrium chamædrys.
Amaranthus prostratus.
retroflexus.
sylvestris.
Polygonum dumetorum.
Asarum europæum.
Aristolochia rotunda.
Euphorbia falcata.
Salix incana.
Limodorum abortivum.
Cephalanthera rubra.
Epipactis latifolia.
microphylla.
Spiranthes autumnalis.
Serapias lingua.
cordigera.
neglecta.
Orchis pyramidalis.
tridentata.
provincialis.
Ophrys apifera.
Gladiolus segetum.
Asparagus tenuifolius.
Lilium bulbiferum.
Ornithogalum pyrenaicum.
Allium pulchellum.
sphærocephalon.
Luzula Fosteri.
nivea.
Lemna minor.
Cyperus flavescens.
longus.
Eleocharis Holoschænus.
Carex Linkii.
pendula.
Andropogon Ischæmum.
Digitaria filiformis.
sanguinalis.
Setaria verticillata.
Melica ciliata.
Sesleria elongata.

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Kœleria phleoides.
Cynosurus echinatus.
Eragrostis pilosa.
megastachya.
Briza minor.
maxima.
Bromus erectus.
Festuca bromoides.
uniglumis.
elatior.
heterophylla.
Cystopteris fragilis.
Adiantum Capillus-Veneris.
Pteris aquilina.
Lomaria spicant.
Asplenium Ruta-muraria.
Asplenium septentrionale.
Trichomanes.
Adiantum-nigrum.
Athyrium Filix-fœmina.
Ceterach officinarum.
Scolopendrium vulgare.
Aspidium lobatum.
aculeatum.
angulare.
Lastrea Filix-mas.
Thelypteris.
Polypodium vulgare.
Phegopteris.
Gymnogramme leptophylla.
Osmunda regalis.

About three miles above La Villa there is a large piece of old alluvial ground by the river, which is now covered with a varied and luxuriant vegetation, including large shrubs of *Alnus glutinosa*, *Salix alba* and *incana*, *Juniperus communis*; also some fine examples of *Verbascum Lychnitis* and *floccosum*, *Spartium scoparium* and *junceum*, *Chondrilla juncea*, *Inula viscosa*, &c.

Among the less common species I may mention having gathered

Linum tenuifolium.
angustifolium.
Astragalus purpureus.
Saponaria ocymoides.
Œnothera biennis.
Santolina chamæ-cyparissus.
Satureia montana.
Chenopodium Botrys.

Two or three miles further up, near the villages of Cocigliа and Casoli, and where the river makes its way through rather a narrow rocky gorge, there is an old wooden bridge called Ponte Nero; I found this one of the best localities in the neighbourhood. Here is a list of some of the plants I gathered on the rocks and among the bushy places on either side:—

Arabis albida.
muralis.
Erysimum cheiranthus.
Helianthemum Fumara.
Silene Armeria.
Hypericum Coris.
Acer opulifolium.
Rhamnus alpina.
Cytisus Laburnum.
Ononis columnæ.
Potentilla argentea.
Amelanchier vulgaris.
Saxifraga aizoon.
lingulata.

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Saxifraga cuneifolia.
rotundifolia.
Bupleurum aristatum.
falcatum.
Cnidium apioides.
Peucedanum Cervaria.
Schottii var.
petræum.
Laserpitium Siler.
Cornus mas.
Asperula taurina.
Galium sylvaticum.
sylvestre.
Inula squarrosa.
salicina.
hirta.
Asteriscus spinosus.
Pyrethrum Achilleæ.
Artemisia camphorata.
Echinops sphærocephalus.
Leontodon anomalus.
Lactuca perennis.
Hieracium sp.
Campanula medium,
Lithospermun graminifolium.
p. cæruleum.
Odontites lutea.
Melampyrum nemorosum.
Satureia montana.
Micromeria Juliana.
Scutellaria columnæ.
Teucrium montanum.
Globularia incanescens.
Salix incana.
Cephalanthera rubra.
ensifolia.
Aceras Anthropophora.
Ophrys arachnites.
Allium pulchellum.
Bromus erectus.
Adiantum Capillus-veneris.

Higher up the valley, and above the village of Vico, there is a mountain known as Monte di Vico, which I ascended once in August, and where I was fairly successful. There was plenty of *Lithospermum graminifolium* in good fruit, and *Arenaria Saxifraga;* here also I found *Allium ochroleucum, Selinum sulcatum, Sisymbrium Zanonii, Primula auricula, Leontodon anomalus;* for all of these this is a new locality in Tuscany.

In the Serchio valley, near Ghivizzano, where the bed of the river occupies a very large area, I have collected—

Ononis natrix.
Medicago arvensis.
Trifolium fragiferum.
Inula viscosa.
graveolens.
Xanthium macrocarpum.
Heliotropium europæum.
Plantago Cynops.
Chenopodium Botrys.
hybridum.
Digitaria filiformis.
sanguinalis.
Eragrostis pœformis.

Above Ghivizzano, on the walls of Coreglia, I gathered *Conyza sordida* and *Ruta bracteosa;* and at Vitiana, *Senecio erucifolius.*

On the opposite side of the river there is a small valley of the Apuan Alps called the "Turrite Cava," where I was

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fortunate in finding several plants of *Omphalodes verna* on the shady side of the stream; also *Trochiscanthes nodiflorus;* this is a new locality for both these rare species. I also gathered *Thalictrum flavum*, *Lonicera etrusca*, *Scabiosa succisa* (not a common plant in Tuscany), and *Inula salicina.*

A few miles lower down the valley, near Borgo a Mozzano, I gathered—

Silene otites,
Ruta angustifolia,
Colutea arborescens,
Dorycnium hirsutum,
Centaurea alba,
Thrincia tuberosa,
Scilla autumnalis;

and in the bed of the river, *Verbascum sinuatum*, *Eryngium campestre;* here also *Inula viscosa* and *graveolens* are very abundant.

The Pratofiorito, which is situated about midway between the Baths and the central chain of the Apennines, and rises to a height of about 4200 feet, is well-known as being the best locality in the neighbourhood for the abundance of many beautiful wild flowers, such as—

Narcissus poeticus,
Gentiana acaulis,
utriculosa,
Pæonia peregrina,
Primula suaveolens,
Potentilla aurea,
Bellidiastrum Michelii,

which, toward the end of May and beginning of June, make a brilliant display. The turf is itself a beautiful sight in the early summer for its rich vivid green colour. These turf-slopes descend rather steeply from the summit, with an aspect almost due north; whilst to the south the mountain presents rather a precipitous appearance.

Besides the plants above mentioned, I collected the following on this mountain :—

Orchis sambucina.
var. purpurea.
Carex ornithopoda.
sempervirens.
Festuca spadicea.
Helianthemum polifolium.
Astragalus purpureus.
Astragalus depressus.
Veratrum nigrum.
Saponaria ocymoides.
Erysimum Cheiranthus.
Ranunculus montanus.
Veronica prostrata.

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And later in the season—

Hypericum Reicheri.	Spiræa Filipendula.
Senecio Doronicum.	Orobanche cruenta.
Thesium alpinum.	Globularia incanescens.
Calamintha alpina.	Sempervivum tectorum.
Euphorbia verrucosa. var. flavescens.	Pyrethrum Achilleæ.

To the south of the Baths the wooded hills extend for seven or eight miles, rising gradually to more than 3000 feet above the plain of Lucca. These are the "Monti Pizzorne." Near the summit I gathered *Mœnchia mantica*, *Sagina subulata*, and *Spiræa Aruncus;* and in some damp sandy hollows, *Aira cæspitosa*, *Illecebrum verticillatum*, and *Poa compressa*. And the following on marshy ground: —*Ranunculus flammula*, *Potamogeton natans*, *Montia fontana*, *Callitriche stagnalis*, and *Carex grypos*.

Excursion to the Apuan Alps (July 7th and 8th).

I only once had an opportunity of visiting the higher portions of these mountains, and then obtained only an idea of the richness of their flora. The attraction for my companion, who was a geologist, was the promise of finding various kinds of marble said to exist near the summit of the Pania.

We started from La Villa early in the afternoon, and drove about ten miles up the right bank of the Serchio Valley to the village of Gallicano, which lies at the foot of the Apuan Alps, on the Petrosciana torrent. Our intention was to pass the night at the little village of Forno Volasco, about eight miles up the stream. The scenery all the way from Gallicano is exceedingly grand; on either side are fine limestone cliffs, well wooded on their summits, and from their bases to the stream below; and the winding mule-path reveals continually fresh scenes of beauty and grandeur, with occasional glimpses of the lofty peaks of the Pietro Pania (or Pania della Croce), which is more than 6000 feet above the sea. The path almost all the way leads through chestnut-woods. On some rocks, a short distance from Gallicans, I gathered *Buphthalmum*

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flexile, Bert., a plant resembling *B. salicifolium*, and peculiar to Tuscany, *Rhamnus pumila*, *Salix cratægifolia*, and *Corydalis ochroleuca*. About half-way to Forno the path ascends considerably above the stream on its right bank, and here one gets a good view, far up the valley, of Monte Forato, remarkable for the large hole there is through it near the top, and which, as we saw it, looked like a patch of snow. We arrived at Forno at about eight P.M., and had some difficulty in finding a lodging for the night; we finally succeeded, however, in being taken in at the principal house, and a very rough place it was. The fireflies were still flitting about when we rose the next morning, and we were well on our way before sunrise, and above the chestnuts. On some rough pasturage, about 1000 feet above Forno, I gathered *Scabiosa graminifolia* and *holosericea*, *Robertia taraxacoides*, and two or three specimens of a beautiful *Cirsium*, which Professor Parlatore pronounced to be *C. pannonicum*, Gaud., a plant not previously recorded in Tuscany. We now began the ascent of the long steep slope which the Pania presents to the south-east, and which is directly exposed to the morning sun. My friend, who was bent on getting specimens of the marble, continued the ascent to the summit; whilst I was anxious to make for the high ridge to the left, which overlooks the country about Serravezza, and in that direction presents some fine cliff scenery. On these crags there was a choice collection of brilliant-coloured flowers, such as *Lithospermum graminifolium*, *Globularia incanescens*, *Hieracium villosum*, *Rosa glandulosa*, *Biscutella lævigata*, *Cerastium apenninum* (a new species shortly to be described by Professor Parlatore), *Bupleurum falcatum*, *Thesium intermedium*, and many others. On returning to Forno Volasco I explored some of the shady parts of the stream, and found *Trochiscanthes nodiflorus*, *Asarum europæum*, &c.; and on the walls about Forno plenty of *Sedum monregalense* and *Asplenium septentrionale*. We returned to Gallicano in the evening, and on the way I gathered *Senecio laciniatus*, *Iberis umbellata*, &c.; and from Gallicano we drove back to the Baths of Lucca.

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Excursions to the Higher Apennines.

I twice had the pleasure of finding myself on the main ridge of the Tuscan Apennines. On the first occasion I went with my brother and a friend who were anxious to know if, as a matter of walking, it were practicable, by ascending to the pass of the Foce a Giogo under Monte Rondinaio, to proceed along the ridge eastward to the pass of the Abetone. As we had no reliable map with us, and no one of whom we inquired seemed to know much about the topography of the mountains, although their opinions generally inclined to the idea of its not being possible, we determined to try for ourselves, and see if it could be done.

We started from La Villa at four o'clock on the morning of July 24, and crossed over the hill above the old village, and down to the stream called the Camaglione, which rises near the Pratofiorito, and runs into the Lima, close below the Ponte a Serraglio. The mule-path, after skirting the stream for some little distance, crosses it near a water-mill by an old bridge, and soon after ascends to the left by rather steep zigzags up to the picturesque village of Riolo, and from there to the summit of the ridge which divides the valley by which we ascended from the wider one of the Fegana. Up to this point we had been walking almost all the way through chestnut woods, which cover nearly all the hills to the height of 2500 feet. The Fegana rises on Monte Rondinaio, and after a course of about twelve miles joins the Serchio at the Ponte Rotto. In this valley are some most picturesque villages, such as Vitiana, near which one gets a magnificent view towards the upper Serchio Valley, or Garfagana as it is called, with the bold peaks of Carrara Mountains towering upon the left. Further up, on the same side of the valley, is Tereglio, where an enthusiastic local botanist lived, the late Dr Giannini. A list of Apennine species compiled by him has been published in a work on the Baths of Lucca, by Dr Carina.*

The path now keeps along the top of the ridge for some distance, still through chestnut woods. The vegetation of these woods is very uniform throughout the district of the Baths, though, perhaps, there is greater variety in the lower

* "Dei Bagni di Lucca, Notizie Topografiche, storiche e mediche." Firenze, 1866.

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parts where the ground is damper. The following appear to be the most generally distributed plants in the chestnut woods:—

Ranunculus nemorosus.
Helleborus viridis.
Cistus salvifolius.
Helianthemum guttatum.
Viola sylvatica.
Polygala vulgaris.
Dianthus Seguierii.
Silene inflata.
Armeria.
Linum catharticum.
gallicum.
Geranium nodosum.
Sarothamnus vulgaris.
Genista pilosa.
Germanica.
Cytisus triflorus.
Astragalus monspessulanus.
Lathyrus Aphaca.
Sanicula europæa.
Œnanthe pimpinelloides.
Daucus carota.
Solidago virgaurea.
Helichrysum angustifolium.
Filago gallica.
Senecio erraticus.
Carlina subacaulis.
vulgaris.
Centaurea transalpina.
maculosa.
Scolymus hispanicus.
Picris hieracioides.
Hieracium crinitum.
Jasione montana.
Campanula Trachelium.
Erica arborea.
Calluna vulgaris.
Cyclamen neapolitanum.
Cynanchum vincetoxicum.
Digitalis lutea.
Euphrasia officinalis.
Orobanche major.
Calamintha officinalis.
Salvia glutinosa.
Melittis melissophyllum.
Teucrium Scorodonia.
Rumex acetosella.
Daphne Laureola.
Euphorbia Cyparissias.
Limodorum abortivum.
Cephalanthera rubra.
Epipactis latifolia.
Spiranthes autumnalis.
Habenaria bifolia..
Orchis tridentata.
Ruscus aculeatus.
Luzula nivea.
Fosteri
maxima.
campestris.
Sesleria elongata.
Cynosurus echinatus.
Festuca heterophylla.
Asplenium Adiantum-nigrum.
Pteris aquilina.
Lastrea Filix-mas.

Further on, the path begins to descend, and soon after the remarkable-looking village of Montefegatese comes into view. It is built all round the sides of a conical-shaped rock, which forms the abrupt termination of a ridge, and on the other side was the small stream called the Volania.

There is a quantity of red jasper about here which is beautifully exposed in variegated bands in the bed of the stream below.

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Here we halted for a short time, and had our breakfast by the side of a cool spring, and enjoyed the fine view, with Monte Rondinaio in the background. High up, under the shoulder to the right, we could see a small white spot, which was, we hoped, to be our resting-place for the night. This is the Spedaletto or hospice, built by the side of the old, now abandoned road to Modena, and which we could distinguish on the opposite side of the valley winding up towards the summit of the pass. After crossing the Volania, we soon entered the quaint little mountain village of Montefegatese. Its network of narrow streets extends in every direction, and at almost any angle; and when the summit is reached, one stands on the top of the rock, which protrudes a little above the houses. We had now to go down a steep rocky path in order to reach the bed of the river, a few miles higher up at the Ponte a Gaglio, where we met a man who, during the summer, lives here in a small cottage, and from him we learnt that the Spedaletto was no longer inhabited; he gave us hopes, however, of being able to get some sort of shelter for the night at one of the chalets close by. As we did not expect to reach any civilised place until late on the following day, we thought it prudent to send back to Montefegatese for some provisions, in the shape of bread and eggs, and this caused a delay of about two hours, which I took advantage of by exploring the wild rocky torrent called the Pelago, which rushes down by the cottage, and under the bridge, to join the Fegana. The following are a few of the plants I noticed on the steep rocks on either side:—

Arenaria saxifraga.	Adenostyles alpina.
Cnidium apioides	Acer pseudo-platanus.
Doronicum Columnæ.	Saxifraga aizoides.

It is impossible to ascend far up the bed of this torrent, on account of the precipitous rocks over which the water falls; but if I ever happen to be botanising again in this neighbourhood, I should endeavour, by keeping well above the stream at either side, to follow it up to its source on the Tre Potenze, a first-rate mountain, I believe, for plants, and within easy reach of the inn at Boscolungo, near the Abetone pass.

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Close to the Ponte a Gaglio, I noticed—*Teucrium Botrys*, *Melissa officinalis*, *Parnassia palustris*, and many others.

Having secured our provisions, we started on our way again up a zigzag path, and along the side of a hill composed of loose shaly rock, which reflected the heat of the sun to an unbearable degree; and now and then we passed through patches of cultivated ground until we got fairly up to the region of the beech and subalpine pasturage. On these Apennines of North Tuscany, the beech ranges from about 3200 to 5000 feet, and is the last tree to be met with as you ascend. The flora of this part of the valley, which is known as the Musceta, is a rich one in some respects, and plants such as the following may be gathered:—

Thalictrum aquilegifolium.	Scorzonera humilis.
Trollius europæus.	Cirsium Erisithales.
Viola Valderia.	Hieracium grandiflorum.
Chærophyllum aureum.	Veratrum lobelianum, &c.
magellense.	

Many of them were being mown down when we were there. We at last found the small house to which we had been directed, and which, after inspection, we did not consider very hopeful for spending the night in. We were thankful for the provisions we had brought with us, as there is little to be procured in these places fit to eat. They gave us some fresh milk cheese, called "ricotta," which, rather to our surprise, we found to be excellent. They make a good deal of it in this part of the country, and send it down to the market bound up in twigs and leaves.

After a short rest we went to explore the ground higher up, towards the old hospice, where I gathered specimens of

Spergula glabra.	Alchemilla alpina.
Sagina saxatilis.	Saxifraga aspera.
Epilobium alsinifolium.	Senecio laciniatus, &c.

From this point it is easy to ascend Monte Rondinaio, a mountain over 6000 feet, and a good locality for rare plants. As we intended to make an early start the next morning, we soon turned into our quarters for the night, which consisted of a hay-loft adjoining the cottage. It is unnecessary to say more than that, in spite of the noises and smell of

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goats, sheep, and cows, which occupied the ground-floor, and from which we were separated by a few loose planks only, we managed to sleep very well.

The tops of the mountains were covered with clouds when we rose the next morning, soon after three o'clock. Having engaged a shepherd-boy to take us by the short cuts through the beech-scrub, we soon arrived near the summit of the pass (about 4800 feet). In some places the old road is entirely broken away, and it affords an interesting example of the effect of weather on what must have been at one time a fine road. Although I felt much tempted now and then to explore some of the wild-looking gullies which we occasionally passed, I was able to do no more than grab at a few things I saw in the crevices of the rocks by the side of the road, such as—*Viola biflora*, *Silene rupestris* and *saxifraga*, *Galium sylvestre*, one or two species of *Hieracium*, *Juncus alpinus* and *trifidus*.

On the damp turfy slope on the Modena side of the pass, and where the snow had probably only lately disappeared, I remember noticing the following:—

Geum montanum.	Viola calcarata.
Cryptogramme crispa.	biflora.
Lycopodium alpinum.	Crepis aurea.
Gnaphalium supinum.	Caltha sp.
Phyteuma hemisphericum.	Polygala, &c.

We were now forced to give up the idea of proceeding along the main ridge as we had hoped, for the clouds were still low, and our guide did not seem competent or inclined to show us the way, so we kept to the road for several miles until we got down to the village of Fumalbo, where we found a conveyance to take us up to the Abetone. On the way down to Fumalbo I had the pleasure of coming upon some plants of *Cardamine asarifolia*, a plant I had been anxiously looking for. It grows by the side of shady streams in the region of the beech. As the day advanced the sky became clearer, and we could distinctly see as we drove up from Fumalbo what should have been our route in the morning along the ridge to the Abetone, and which, besides having the advantage of being shorter, would

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no doubt have been much more productive of botanical treasures than the way we took.

As you approach the Abetone, the road enters the beautiful pine-woods which extend on both sides of the pass, descending to rather a lower level on the Modena or northern side. The height of the pass is about 4400 feet above the sea. It is the dividing point between the Apennines of Pistoia, and those of Lucca to the west; whilst the main ridge itself forms the boundary-line between the old duchies of Modena and Tuscany. There are some good plants to be found in the pine-woods, but I had no time to explore them sufficiently on this occasion. I gathered specimens of the following:—

Doronicum austriacum.
Phyteuma Halleri (with pale-coloured flowers.)
Senecio nemorensis.
Prenanthes purpurea.
Ranunculus lanuginosus.
aconitifolius.
Gnaphalium sylvaticum.
Sambucus Ebulus.

In the evening I took the opportunity of climbing with my brother the high part of the main ridge to the west, where I found some very interesting species. We managed to pick our way through the woods by taking advantage of the small cylindrical stones which mark the boundary-line between Modena and Tuscany. Each of these stones, which are about 50 or 60 yards apart, is marked on its flat top with lines to indicate the direction of those on either side. In this way we soon reached the summit of the ridge, and just in time before sunset to see a magnificent view in all directions. The Pistoia Apennines, commencing on the opposite side of the Abetone pass, with the high peaks of the "Libro Aperto" and "Cimone" (both over 6000 feet) curve round to the south, and fade into the distant outline of the Vallombrosa Mountains, below which we could see, in the valley of the Arno, the city of Florence distinct in the light of the setting sun. To our right the ridge extends to the Tre Potenze, a mountain so named from its three principal peaks, which are said to command the provinces of Lucca, Modena, and Tuscany; whilst immediately below is the richly-wooded valley of the Sestaione, which, starting from the last-named mountain,

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joins the Lima Valley near the village of Cutigliano. There were still a few patches of snow lying close under the top of the ridge on the Modena side, helping to feed the streams which find their way through the dense pine-woods below. There was not much time for collecting plants, but the following is a list of those I remember to have gathered or seen on the way up:—

Neottia nidus-avis.
Galium sylvaticum.
Cryptogramme crispa.
Polystichum Lonchitis.
Arenaria saxifraga.
Silene quadrifida.
Carex sempervirens.
Trifolium cæspitosum.
Aira flexuosa.
Potentilla aurea.
Asperula longiflora.
Calamintha alpina.
Phyteuma hemisphericum.
Globularia incanescens.
Seseli Libanotis.
Leontodon anomalus.
Robertia taraxacoides.
Hypericum Reicheri.
Crepis aurea.
Draba aizoides.
Viola calcarata var. Zoysii.
Alsine verna.
Saxifraga muscoides.
Euphrasia officinalis, var: minima.
Hieracium, Sp.

After a good night's rest at the inn of Boscolungo, we started off the next morning to walk to the Baths of Lucca (about 25 miles), by the fine road which extends along the whole course of the Lima Valley. Near Cutigliano, about six miles down the road there are some good plants, such as *Tommasinia verticillaris* and *Trochiscanthes nodiflorus*. Four miles further down there is a large paper-manufactory where the road divides, that to the left leading to Pescia and Pracchia by San Marcello, whilst the one to the right, following the river, is the road to Lucca. The hills here are almost entirely covered with chestnut trees. About five miles along the road, as you pass under the picturesque villages of Lucchio, Vico, and Limano, a good view is obtained of the beautiful turfy slopes of the Prato-fiorito. After this, the valley becomes more contracted, and the steep rocks on either side support a rich and varied vegetation, especially in the vicinity of the old wooden bridge called Ponte Nero. I have already given a list of some of the more interesting species which I found on various occasions at this first-rate locality.

The distance from Ponte Nero to the Baths is about six

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miles. I have nothing to add to the foregoing remarks as to the flora of this part of the Lima Valley.

On my second visit to the higher Apennines I enjoyed the advantage of having as a companion my friend M. Sommier of Florence, who is well acquainted with the flora of Tuscany, and had shortly before been collecting in the Monte Amiata district. We met at Boscolungo on the 13th of August. There had been a severe hailstorm a few days before, which had cut up the trees and shrubs terribly, and the woods were carpeted with leaves and small branches. In the evening we explored one of the torrents which comes down through the pine woods on the Modena side of the pass. Here we were very successful, as the following list of plants will show :—

Cardamine asarifolia (plentiful in the bed of the stream and in good condition).
C. resedifolia.
Valeriana tripteris.
Sisymbrium Zanonii.
Heracleum Pollinianum.
Sedum monregalense.
Galium sylvaticum.
Lonicera alpigena.
Asplenium viride.
Polystichum Lonchitis.

There was abundance of *Colchicum alpinum* in a meadow near the inn.

We arranged to go the next day to Lago Nero, a sort of mountain tarn lying at the head of the Val del Sestaione, and immediately under the Tre Potenze. Our plan was to go by the ridge along the boundary line of stones as far as the Tre Potenze, and from there to descend to the lake, and return by the Sestaione Valley. The ground was new to both of us, excepting the first part of the ridge, where I had been on my previous visit to the neighbourhood.

We found the following plants, in addition to those I mentioned at page 81 :—

Anemone alpina.
Hieracium auricula.
Sisymbrium Zanonii.
Luzula spicata.
Empetrum nigrum.
Leontodon hispidum.
var. glabratum.
Pyrola minor.
Cuscuta (on Vaccinium Myrtillus).

After leaving the ridge, we descended by a sort of sheep-path which skirts the base of some rocks by the side of

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Monte Faitello. These rocks are in the form of shelves, inclined at an angle of about 20°, and dipping north. I shall long remember the delight of exploring these immense steps of rocks, every crevice and corner being occupied by something new or interesting, such as:—

Linum alpinum.	Dianthus deltoides and sylvestris.
Senecio Doronicum.	Centaurea phrygia.
Genista radiata.	Stachys labiosa.
Galium sylvestre.	Betonica hirsuta.
Globularia incanescens.	Phleum alpinum.
Imperatoria Ostruthium.	Polystichum Lonchitis.

Further on we reached some ground where the principal vegetation consisted of *Vaccinium Myrtillus* and *Vitis-idœa;* and soon after we came to a cool spring, which being the first we had come across since leaving Boscolungo, we made the most of.

We soon got a view of Lago Nero, which, as we saw it, is rather a series of small tarns; a more plentiful supply of water may sometimes cause them to unite. By this time our *vascula* were tightly packed, and we were obliged to content ourselves with a very limited supply of the treasures we saw, such as *Juncus filiformis*, *Typha minor* (*?*), *Callitriche* sp., two or three species of *Carex*, including *C. stellulata* and *vulgaris*, *Menyanthes trifoliata*, *Nasturtium palustre* (a small form), and last, but not least in importance, *Elatine triandra*. It is new to the flora of Tuscany, and the locality is interesting, being upwards of 5000 feet above the sea. It was growing plentifully in some of the almost dried-up hollows on the outskirts of the lake. The other localities in Italy are near Milan and Vercelli in Lombardy.

From Lago Nero we followed the stream down the Val del Sestaione. As we descended, the views of the mountains, looking up the valley, with pines and beech trees in the foreground, were strikingly beautiful. The sun was getting low, and the blue smoke rising here and there from the charcoal-burners' fires added greatly to the effect. We had neither time to gather, nor room to stow away any of the interesting plants we saw on the way. A little below Lago Nero we found *Silene quadrifida*, *Saxifraga stellaris*,

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and *Cardamine asarifolia* (several plants along the course of the stream); and in the woods, *Epipactis latifolia*, *Veratrum*, &c. After a while, where the valley turns rather sharp to the right, we had to ascend by a path through the woods to the left, which leads over into the Lima Valley, about a couple of miles below Boscolungo, and were soon back to our inn again. We drove back early next morning to the Baths of Lucca; for having come to the end of our drying paper we were anxious to lose no time in preserving our specimens.

III.—*On the Fertilisation of the Cereals.* By Alexander Stephen Wilson.

The present paper refers to observations and experiments made upon wheat, rye, barley, and oats, during 1873, and corrects one or two mistakes into which the writer had fallen in a previous paper on the subject. (Bot. Soc. Tr. xi. 506.)

1. *Before Fertilisation.*—From the time at which the ears, or part of the ears, of the four European cereals appear above the sheath, till the time of flowering, the styles and the anthers remain in nearly the same position. During this time the filaments are of such length as to place the lower ends of the anthers in contact with the upper part of ovary, while the styles lie embraced by the anthers; the whole being straight and running in the same direction as the axis of the closed pales. (See figs. 1, 3, 5, 7.)

In each of these four cereals the ovary is of a different form; and it may be noticed in passing that the embryo originating in each has well-marked distinctive characteristics. The styles of the oat also differ from those of the wheat, and these again from the styles of the rye and barley. The anthers of wheat, spelt, barley, and oats, nearly resemble each other in length and form. Their upper ends extend nearly half way to the apex of the pales. But in the rye floret the anthers are much longer, and reach very nearly to the termination of the upper pale. The flower cup, or space enclosed by the pales, is smaller and narrower in rye than in the other cereals.

2. *Opening of the Flower.*—"Many authors," says Darwin (*Origin of Species*, p. 316), "maintain that impreg-

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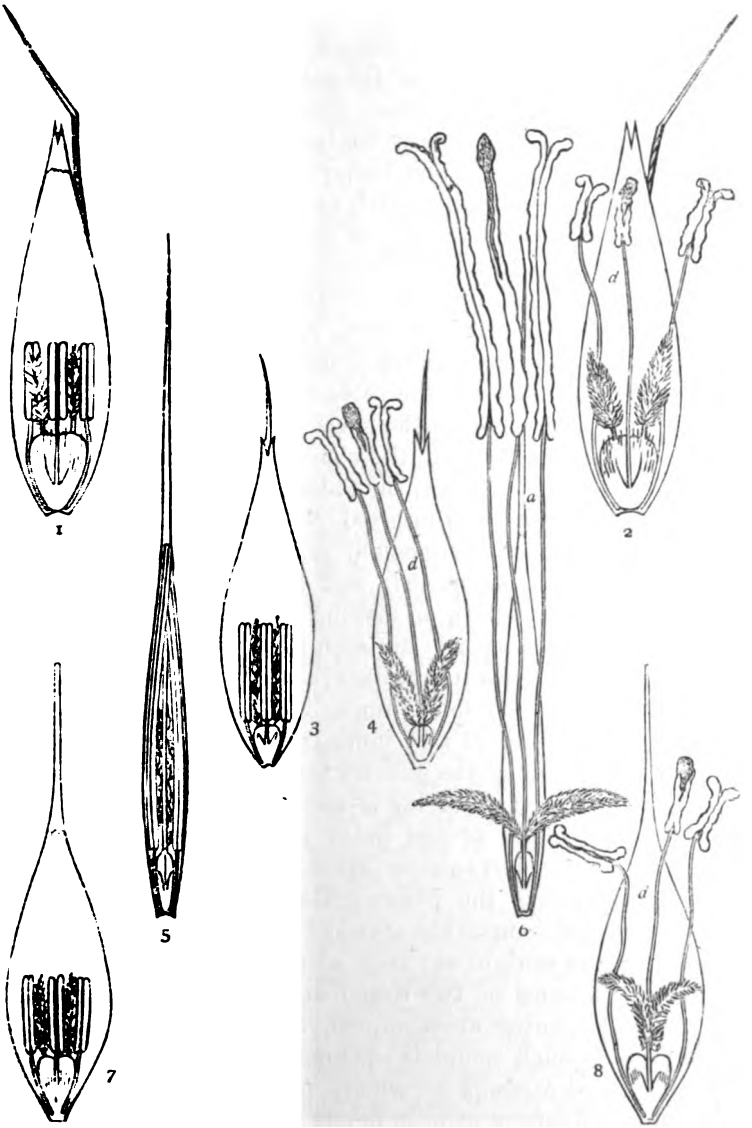
nation [of Wheat] takes place in the closed flower, but I am sure from my own observation, that this is not the case,



1, 3, 5, 7, Oat, Wheat, Rye, and Barley florets, before fertilisation; 2, 4, 6, 8, the same after fertilisation; *d*, point where spontaneous discharge takes place. Scale, four times natural size. A. S. W., *delt.*

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at least with those varieties to which I have attended." We shall see that Darwin and the authors he alludes to are easily reconciled. When we speak of the opening of a flower, we usually mean the obvious distension of the corolla, and the exposure of the anthers and pistil. But in regard to the cereal and other grass flowers, opening is of various degrees. It usually begins about the middle of the spike in wheat, rye, and barley, and at the top of the panicle in oats, while a week or ten days may frequently elapse between the flowering of one part and another.

With what is called the Italian form of two-rowed barley (which is probably the Achillean barley of some of the ancient writers), all the opening necessary for fertilisation, and all that ever takes place, consists in such a mere effort at opening as distends the pales sufficiently to enable the anthers to be pushed up the sides of the flower-cup. If a floret is held up between the eye and the light before fertilisation has taken place, the anthers will be seen through the pales lying in their original position, and if the flower is then opened and inspected, it will be found that the anthers are still unopened, and still retain their bright yellow colour. But if, on looking through the semi-transparent pales, the anthers are seen in the upper part of the cup, fertilisation has taken place; and if the floret is opened the anthers will be found open, with the pollen scattered about on the feathers and inner surfaces of the pales, and the bright colour of the anthers passing away. The inner pale in this form of barley is so tightly embraced by the overlapping edges of the outer pale as prevents further opening. The intra-palear space, however, is sufficiently large to permit of the pollen grains falling down from the discharging slits upon the styles; for the barley in question maintains an upright ear even when ripe.

In other forms of two-rowed and six-rowed barley, all degrees of opening are common, from a mere inflation of the pales to such complete opening as permits the anthers to be pushed partially or wholly out of the cup. But it frequently happens, even in florets which have fully opened, that all the anthers have not been thrown out; they have simply been pushed up to the edge of the pales, and these coming together again have enclosed them, as if the floret

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had not opened at all. This fact must be kept in view by any one who, opening the pales after fertilisation, and finding the anthers still inside, is disposed to contend for the non-opening of such floret. In an ear of Bere (*Hordeum vulgare*) eleven florets on the main rows had thrown out the anthers while three had not; in another, all the florets on the main rows except one had expelled the anthers; in another, all the six rows were opened after fertilisation, and none of the anthers was found enclosed. Delpino contends that opening and non-opening are explained by difference of construction in the florets. There is probably no essential difference in florets of the same rows; but it is quite certain that in some the overlapping of the outer pale is stronger and closer than in others, and that, therefore, the more tightly closed will be least ready fully to open. Observation also proves that the plant is growing more rapidly in one state of the weather than another; and the question presents itself, Has the degree of opening in a given floret any dependence on the current vigour of general growth? None of the rows in the six-rowed varieties seems to have any normal peculiarity in respect of opening; one floret on a row will open fully and fling out its anthers, while another on the same row will retain its anthers till they are pushed out by the ripening fruit.

The different varieties of wheat, so far as known to the writer, observe conditions of opening the flower similar to those of the barleys. Notwithstanding the strength and ultimate rigidity of the pales of spelt, they open even more fully than those of the ordinary wheats. In samples of spelt from Germany, procured by the writer, none of the third florets of the spikelet are fertilised, while in the plants grown by him from these seed many of the third florets are fertile. Many wheat florets never open so far as to give room for the egress of the anthers, some open so far as to allow one or more anthers to get half out, in which position they are caught and held by the reclosing of the pales. In many the anthers are wholly retained, but the general rule is for the floret to open so far as to throw out the anthers.

The rye floret is much longer in proportion to its breadth than the floret of wheat, barley, or oats. The anthers

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occupy almost the whole length, and the whole enclosed space above the ovary. In order, therefore, to fertilisation it is an absolute necessity that the rye floret shall fully open. This is also the case in wheat-grass (*Triticum repens*), and other grasses, in which the anthers are nearly conterminous with the pales. Cases sometimes occur in which the recurved edges of the inner pale so tightly embrace the anther that it cannot be pushed out even when the flower fully opens.

Amongst the oats, very many florets never open their pales so far as to discharge the anthers. In a great number of cases complete opening seems to be prevented in the lower or main floret by the want of sufficient force of separation in its pales, to push aside the secondary floret which it embraces. Another reason why the anthers of oats are so frequently left inside is, that in general the locusta hangs with its apex downwards, so that even when the bracts open wide, the anthers, hanging perpendicularly, are re-enclosed when the flower shuts. But probably there are other causes obstructing full opening; for the lower floret of the fly oat (*Avena sterilis*), although having very stiff pales and closely hugging three or four secondary florets, opens widely in almost all cases. Wide opening is also the general rule with the wild oat (*Avena fatua*). The cultivated oats open, from a slight dilatation of the valves, to a separation at the points of a quarter of an inch. Cases are to be seen in which the anthers of the oat have discharged the necessary part of their pollen almost in their original position, the inference here being that almost no degree of opening has taken place. If a number of florets are opened after fertilisation has occurred, the anthers will be found either absent, or in all sorts of positions corresponding with the degree of opening; they will be found peeping from between the pales, or somewhere betwixt the edges and their original place.

As stated in a previous paper, opening of the cereal flowers takes place at all hours of the day. I have observed that it also takes place in all kinds of weather, wet or dry. I have observed that spelt flowers open in the morning before the sun touched them. I have also seen them open in a dead calm after sunset (9 P.M.), many of

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them had opened and closed within an hour previously. I have likewise seen wheat and spelt flowers open during heavy rain, and in dull cloudy weather. Fertilisation seems to take place when the flower is ripe, independently of any particular state of the weather. In respect of all florets which do not open so far as to eject their anthers, the falling of rain or the blowing of the strongest wind is perhaps a matter of indifference. In respect also of all florets which open pendulously, the falling of rain is obviously a matter of indifference. But when we see, as below, that even in upright, fully opening florets, the fertilising discharge takes place inside the cup, the question occurs, Will not a drop of rain carry the pollen grains down towards the ovary and assist fertilisation?

In wheat, barley, oats, rye, wheat-grass, and probably many other grasses, opening of the flower may be induced by handling the ear in a gentle way when the natural time of flowering has nearly arrived. In rye especially this would form a beautiful lecture-room experiment. I have seen eleven rye florets throw out their bright yellow anthers at the same time on one spike, by simply drawing them through the hand: indeed, the mere transfer of a cut bunch of rye culms from the open air into a warm room will instantly bring out a fine display. Barley and wheat flowers also open from the same causes, though not so freely. The force exerted by some of the grass florets in opening is so considerable that when, for instance, the lowermost inner floret of a spikelet of darnel opens, the spikelet is held apart from the rachis by a tension which counterbalances 110 grains.

Whether the sudden opening of grass flowers upon being touched is to be regarded as a kind of irritability, must at present be passed over. Probably the continued growing of the pollen grains keeps the filaments of the anthers quiescent, until these grains becoming mature, the rising sap is dammed back into the filaments. These are then forced into the sudden growth which takes place. The handling of the spike may simply antedate this process, since it may sometimes be brought about before the pollen is matured, when the anthers are pushed up and tumbled out without

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rupturing. But in general dehiscence follows artificial opening in the same way as it follows natural.

3. *Fertilisation.*—A knowledge of the fact that flowering may be artificially anticipated gives great facilities for observing the methods of fertilisation. These methods may be seen and studied either in the field or in the house, since the ears will blossom well and readily after being cut from the plant and carried home. Indeed, single florets broken from the axis and placed under the microscope, have still so much life and force left in them as to go through in a mournful way the beautiful process of fertilisation, and the botanist may thus perpetrate a little furtive act of vivisection, painful only to the poetic imagination.

Break off a barley floret from an ear which is just coming into blossom; open the pales gently, and put it under a low magnifying power. Presently a slight tremor takes place. The anthers begin to move upward. The filaments are visibly growing before the eye at the real rate of six inches an hour. The anthers get more and more distended. They are now half way up the unpretending green chalice. Observe the little slit commencing near the apex of the more advanced. Out darts a little spurt of tiny bullets. Presently the next and the next opens. Instantly another and another spurt of tiny bullets are sent dancing from each half-open suture over the enclosing sides of the pales, or down upon the spreading feathers. Now and then a solitary ball bounds out of the opening cavity over the plain in front of it, as if it had relieved the elastic pressure of those contiguous to it. But spontaneous projection ceases, apparently on the relief of the internal pressure, although the slit continues to extend into an elliptical pore. Still the anthers move upward. A point inside the pale catches the foremost end of one while the filament is growing and pushing from behind, and it falls over on the round orifice, tumbling out by mere gravity a little heap of grains. Another falls out between the pales, and discharges its remaining contents in the air. The third gets entangled in an overlap, and its unnecessary treasure remains inside. (Compare figs. 2, 4, 6, 8, with figs. 1, 3, 5, 7.)

But the same phenomena may be observed in the field with an eye-glass. In order that all the processes may be

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seen according to the usual method of nature, watch the ears of awny wheat on a calm day until a floret is caught just beginning to separate the point of its awn from the spike. Gently push back the inner pale a little, and the anthers will be seen rapidly moving upward. Generally, by the time their discharging or upper ends have advanced half way up the cavity of the floret, the slits open, and the discharge consequent apparently on the internal pressure of the swollen pollen grains has taken place. The anthers continue to be pushed upward, dropping out a little pollen here and there. But all discharge after the first one or two spurts arises solely from gravity and the downward position of the slits.

As it is a tedious pastime to watch for the natural opening, the opening which is brought about by handling the ear may always be substituted. For while you are examining one floret, others are sure to begin to swell out and give symptoms of opening, so that the essential process may be watched in any number of cases. The opening of an oat flower with a pincers, when near the time of flowering, will bring on the process of fertilisation under the eye, and the same phenomena may be seen as in the case of barley and wheat. Discharge of pollen takes place before the anthers get outside the corolla.

It is thus seen that in those florets of oats, wheat, spelt, and barley, which even fully open, a discharge of pollen takes place before the anthers get outside. Only from three to five minutes elapse from the time when the anthers begin to move until the filaments attain their final length. After extension these filaments are slightly reduced in thickness.

In the case of rye, which is next to be considered, several of the facts are different. As the anthers in the immature position extend almost the whole length of the pales, the least extension of the filaments pushes the upper end of the anthers, where the discharging slit first opens, out of the flower cup altogether. This is also the case in wheat-grass and others. From a single observation, it is probable that the long anther of the feather-grass (*Stipa pennata*) opens first near the lower end. Were this the case in rye, its fertilisation would be better secured than it is. But as

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the rye anthers do not open till beyond the flower cup, certain compensations, as compared with the other cereals, come into play. The quantity of pollen in the rye floret is about ten times greater than in that of wheat, barley, or oats; and on its opening the feathers spring out in curves on both sides.

In various wheats and spelts the points of the feathers are frequently thrown outside, where they are sometimes fixed permanently by the reclosing of the valves, and sometimes they are retracted on the closing of the flower. But the rule in wheat, oats, and barley is, not to expose the feathers. Now, are these precautions taken to fertilise the rye floret successful? We shall see that they are not. We shall see that 24 per cent. of the perfect rye florets in a field are never fertilised.

It thus seems to be the case that wheat, barley and oats, whether they fully or but partially open their flowers, are fertilised before the anthers are visible outside. The coming of their anthers outside, or discharging a remnant of pollen in that position is an accidental circumstance of no essential importance; while with rye an exterior discharge is always essential but frequently a failure. The flowers are seldom open above half-an-hour; and seldom are there more than three or four florets open at one time on a spike.

"It is generally believed," says Mr Alfred W. Bennett (*How Flowers are Fertilised, a Lecture*, 1873, p. 11) "though on this point further experiments are still wanting —that our cereal crops, especially wheat, rye, and barley, are fertilised exclusively by the agency of the wind. The flowers are small and uncoloured, without calyx or corolla; the anthers are hung lightly on the end of long slender filaments; the pollen is very fine and powdery; and insects are hardly ever seen to visit them. Favourable weather (fine and sunny, with light breezes, and yet not so strong a wind as to disperse the pollen to too great a distance, so that it will not perform the purpose for which it was designed) at the time when the plants are in flower—*i.e.*, in the early part of June—is therefore of very great importance for the insuring of heavy crops." But we have seen that the rule which applies to wheat, barley, and oats, does

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not apply to rye. We have seen also that the wind is entirely unnecessary to the fertilisation of wheat, barley, and oats. The Belgian farmers who trailed ropes over their flowering wheat to insure complete fertilisation, were doing that which the very appearance of the anthers told them in whispers, not yet heard, had already been accomplished. The pollen of these plants, which the winds disperse, is not that which fertilises, but that which is not required for fertilisation. It is manifest that in the Italian barley, the largest fruited of all the varieties, and which never opens its pales, nor disperses any pollen in flowering, cross-fertilisation has never taken place in all the lapse of its existence; while in the case of the other barleys, wheats, and oats, even the florets which do fully open are self-fertilised before space is afforded for the admission of neighbouring pollen.

Then in regard to rye. I counted at one time ten ears taken at random from a field when nearly ripe, and found that they contained 450 fertilisible florets. The defective highest and lowest florets on the spike, and the middle florets, which sometimes are fertile but more frequently barren, were left out of the enumeration, and only the four rows taken which are usually fertile; of these 107 were barren. Thus, 76 per cent. of the florets were fertile, and 24 per cent. barren. At another time I took from the sheaf fifty ears, and counting in the same way, found 2297 florets, of which 1750 contained kernels, thus giving 76 per cent. of fertile florets, and 24 of barren, as before.

I placed a pot containing several plants of rye and barley in an unoccupied room immediately before flowering. Here consequently they flowered in a dead calm, unaffected by the wind. When the plants were ripe twenty ears of rye were counted as before, and contained 817 fertilisible florets. Of these only 165 had produced kernels. So that in a dead calm only 20 per cent. of rye florets were fertilised. And if 20 per cent. are fertilised by the falling of the pollen from the expelled anthers in a dead calm, while 76 per cent. are fertilised amid the ordinary breezes of the field, 56 per cent. of rye florets are fertilised by the agency of the wind.

Counting ten ears of Chevalier Barley in the open field,

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there were 285 florets, of which nine were barren, or a little over 3 per cent. The barley grown in the pot was not well attended to, and ten ears which flowered in the house had only 191 florets, of which ten, or about 5 per cent. were barren. The difference of 2 per cent. I believe to be due to defective watering rather than wind; this comparison not having been thought of till after the plants were ripe. But the fact that the percentage of barley fertilised amid the ordinary motions of the air, and the percentage fertilised in a dead calm are practically the same, proves that the fertilisation of barley does not require the aid of wind, and must therefore result from the intra-palear discharge; since the extra-palear discharge in the dead calm falls to the ground, the specific gravity of grass pollen being much greater than that of atmospheric air. It is almost needless to say that one plant of Italian barley of four ears, which also fertilised inside the house, was as fully fertilised as in the field.

Counting the outer rows only of ten ears of various wheats, the percentage of barren florets was $4\frac{3}{4}$.

The main florets of ten ears of Potato Oats in the field numbered 296, of which six florets were barren, or about 2 per cent.

We see, then, that the method of oats, barley, and wheat, more successfully fertilises the ovule than the method of rye. As before hinted, this does not arise from the quantity of pollen being greater in the former than in the latter, but simply because in wheat, barley, and oats dehiscence takes place inside the floret, where, in general, neither wind nor rain can carry away the pollen from the vicinity of the stigma. But barrenness frequently results, not from the non-apposition of pollen, but from defects, or monstrosity. An ear of bere was observed with the flowers on the main rows gaping open, but with the anthers inside shut and destitute of pollen. Emptied anthers speedily get blanched and shrivelled, and, in many grasses, the discharging sutures soon open from end to end. Where anthers are seen hanging outside, straight and yellow, or purple (which they sometimes are), they will be found defective. The stigma is also sometimes defective. An ear of bere was observed, in each floret of which were clustered three ovaries, having two

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feathery styles each, while the anthers were merely rudimentary.

4. *Points of Structure.*—A transverse section of a rye anther, a little before puberty, shows four cylinders around the connective, although structurally there are but two lobes. Each cylinder shows about twenty-six grains attached round the interior surface, and leaving the central part of the loculus open from end to end. Making the necessary micro-measurements, each anther of rye is found to contain about 20,000 grains, the three anthers together giving 60,000 grains of pollen for the fertilisation of what is usually considered one embryo, but which, perhaps, may more properly be regarded as a cellular mass, capable of evolving fifty embryos, one of which takes the lead in the ovary, but two others of which may generally be therein detected.

The pollen of three triplets of rye anthers poured into the pan of a delicate balance was found to weigh ·37 of a grain. Each floret, therefore, of a fair-sized spike of rye contains ·123 of a grain of pollen, and each anther ·041—so that 500,000 ellipsoids of rye pollen are required to make 1 grain weight.

Measuring and weighing the pollen of wheat in the same way a spelt floret was found to contain 6240 grains of pollen, and a spring wheat floret 6864. A set of spelt anthers (which are about the same size as those of the other wheats, barley, and oats), was found to contain a weight of pollen of ·016 of a grain. This is only about one-eighth of the weight contained in a set of rye anthers. But the pollen grains of wheat are larger and more spherical than those of rye, so that it takes only 390,000 of these balls to weigh a grain, and while to produce a rye kernel about one-sixth its weight of pollen is required, to produce a wheat kernel only one-fortieth its weight is required. It would be easy further to show that an acre of wheat may produce 50 lb. of pollen, and an acre of rye 2 cwt.; but such calculations are less suited to strict science than to the gratification of popular curiosity.

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IV. *The Lochwood Oaks in Annandale, Dumfriesshire.*

By James M'Nab.

In November 1873, I visited the forest of old oaks at Lochwood, in Annandale, Dumfriesshire, the property of Mr Hope Johnstone, 7 miles from Moffat, and 3 from Wamphrey Railway Station. On the top of a wooded slope stand the remains of Lochwood Tower, supposed to have been built about the fourteenth century. It is surrounded by an oak forest of considerable extent. The trees average from 9 to 14 feet in circumference, and 30 to 50 feet in height: where the branches begin to diverge, the girth is generally larger than at the base. Nearly all the trees are in a decayed or decaying condition. The chief or upright portion of their stems varies from 6 to 8 feet in height, after which they divide, and the spread of branches sometimes measures 60 feet in diameter, almost all of them being coated with a variety of mosses and lichens. At the time of my visit, these trees were clothed with the common polypody (*Polypodium vulgare*), and notwithstanding the enormous quantity of this fern, no varieties of it were seen. The trees cannot be less than 300 years old, and judging from their appearance, the tops have been removed at an early period of their growth, either for the bark, or to induce a spread of branches, to make them useful in naval architecture. The soil in which they stand is exceedingly good, having been enriched with decaying leaves, and judging from the mossy state of the stems and branches, it is naturally damp, which has probably hastened the decay of the stems.

Dr Walker, in his essays on "Natural History" and "Rural Economy," in 1812, says that one of these oaks in 1773 measured 14 feet in circumference. He also states that, judging from some that were cut down, they were (in 1773) about 230 years old. But as far as can be gathered from the older inhabitants, they are probably now not less than 500 years.

Of the *pouch* firs, planted by Dr Walker in the glebe at Moffat, between 1762 and 1783, only two exist, one a fine specimen of the Scotch fir (*Pinus sylvestris*) with a stem 9 feet 2 inches in circumference, at 3 feet above the ground,

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and about 50 feet in height, and apparently not less than 100 years old. Dr Fleming, in Bot. Soc. Tr. v. 142, calls the pouch fir the cluster pine (*Pinus Pinaster*), a specimen of which is growing 70 yards from the old Scotch fir. This tree is 6 feet in circumference at 3 feet above the ground, and between 50 and 60 feet in height.

Dr Macvicar is endeavouring to prolong the existence of the old Scotch fir, some injured branches being covered with lead to keep them from moisture.

V. *Report on the Open-Air Vegetation at the Royal Botanic Garden.* By James M'Nab, Curator.

Owing to the comparative mildness of the past winter the number of species in flower at this date (Feb. 12) is twenty-eight; a number greatly exceeding those noticed at any previous February meeting of the Society. Since last meeting (Jan. 8) the thermometer has been fourteen times at or below the freezing point, the lowest markings being on the mornings of the 20th and 25th of January, and the 9th, 10th, 11th, and 12th of February, indicating respectively 24°, 28°, 25°, 26°, 17°, and 26°. The highest morning temperatures were on the 9th, 14th, 16th, 21st, 29th, and 30th of January, indicating respectively 40°, 47°, 56°, 40°, 47°, and 46°.

Vegetation is between five and six weeks in advance of the corresponding date last year, as may be seen below:—

	1874.	1873.
Primula denticulata	Dec., 1873	Jan. 8
Hepatica triloba and varieties	„	„ 10
Corylus Avellana	„	„ 14
Jasminum nudiflorum	„	„ 15
Dondia Epipactis	„	„ 15
Tussilago fragrans	„	„ 16
Aubrietia grandiflora	„	Mar. 17
Rhododendron atrovirens	Jan. 4	Feb. 19
Leucojum vernum	„ 10	„ 9
Galanthus nivalis	„ 10	Jan. 9
Sisyrinchium album	„ 12	Feb. 28
Eranthis hyemalis	„ 14	Jan. 15
Crocus susianus	„ 14	Feb. 14
Galanthus plicatus	„ 15	„ 10

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	For 1874.		1873.	
Sisyrinchium grandiflorum roseum	Jan.	15	Feb.	16
Rhododendron Nobleanum . .	„	16	Mar.	18
Scilla præcox	„	24	„	3
Crocus vernus and varieties . .	„	26	Feb.	17
Mandragora vernalis . . .	„	30	Mar.	18
Scilla sibirica	„	30	„	7
Orobus vernus	Feb.	1	„	15
Bulbocodium vernum . . .	„	2	„	2
Scilla bifolia	„	2	„	9
Draba aizoides	„	2	„	18
Symplocarpus fœtidus . .	„	3	„	24
Cynoglossum Omphalodes . .	„	5	„	25
Nuttallia cerasiformis . . .	„	7	April	17
Nordmannia cordifolia . .	„	9	Feb.	25

The first seven species came into flower twice within twelve months.

The following table shows the number of the selected plants in flower on the second Thursday of February for the last ten years. Many other species were in bloom during the time specified, but are not enumerated:—

February,	1864,	6 species.	February,	1870,	1 species.*
„	1865,	4 „	„	1871,	None.†
„	1866,	10 „	„	1872,	9 species.
„	1867,	8 „	„	1873,	9 „
„	1868,	10 „	„	1874,	28 „
„	1869,	17 „			

At p. 62 I stated that on January 1st, 138 species of plants were picked in bloom, showing the extreme mildness of the season. This mildness continued throughout January and the early part of February, and has greatly advanced vegetation. On February 9th flowering specimens of 132 species and varieties of trees, shrubs, and herbs were picked in the open air; of these about seventy-six may be considered as summer and autumn plants, and the remaining fifty-six as winter and spring flowering varieties.

The frost experienced since the 9th has injured many premature flowers of the sorts now exhibited. This frost will have a tendency to injure the blossom of many fruit trees, particularly the pear, now in an advanced state.

* Snowdrop, February 2.
† First Snowdrop opened, February 18.

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Miscellaneous Communications.

1. Professor Balfour read a communication from his son, Sub-lieutenant Andrew F. Balfour, of Her Majesty's ship "Challenger," giving a list, by the Botanist of the Expedition, of some of the plants peculiar to Nightingale Island, one of the *Tristan d'Acunha* group in the South Atlantic Ocean, visited in the course of the scientific cruise. The most interesting tree on the island was *Phylica arborea*, P. Th., of which specimens were sent by Mr Balfour for the herbarium at the Royal Botanic Garden.

2. A note was read from Mr James Leslie, C.E., in which he stated that on the Greenheart (*Nectandra Rodiœi*) piles of Easdale Pier, west coast of Argyllshire, driven in November or December 1872, a growing specimen of tangle (*Laminaria digitata*) was found 12 feet in length, on 23d September 1873.

3. Professor Dickson exhibited specimens of *Polyporus brumalis*, a rare British fungus, collected by him near Carluke.

Thursday, 12th March 1874.—Sir WALTER ELLIOT, K.S.I., Vice-President, in the Chair.

The following Candidates were elected as Resident Fellows:—

Professor LISTER.
JOHN MACMILLAN, M.A.
JAMES BELL PETTIGREW, M.D.

The following Communications were read:—

I. *Notice of a new Lepidodendroid Fossil from Devonside, Tillicoultry, with Remarks on other Fossil Plants.* By CHARLES W. PEACH, A.L.S.

The author first referred to a specimen of a fossil plant which he had noticed in the Dundee Museum, marked as *Bothrodendron*, from Alfreton coal-fields, Fifeshire, which on examination appeared to be *Megaphyton*. Although the

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specimen possesses the dots and other characters mentioned by Lindley and Hutton, the rows of scars on each side differ much from those of *Megaphyton*, which show circular radiating markings at the bottom of the concavities, as if made by cones, and the scars are far distant from each other on the stem; whereas in the Dundee specimen they touch each other, and have a ridge up the centre dividing the scar into two parts, with the double "horse-shoe" at the top, and instead of the smooth radiated lines in the bottom of each concavity, have a ragged fibrous structure, as if large leaves or branches had been torn off. It therefore agrees more with that figured by Lindley and Hutton as *Megaphyton distans*, than with *Bothrodendron*. Mr Peach illustrated his remarks by a cast and drawings. He considered the fossil new to the Scottish coal-fields.

He next noticed a specimen of Lepidodendron from Deeside, Tillicoultry. The leaf scars on each rib, instead of being in a single row, have lines of two or three ranged diagonally across each rib, and had on the outer bark scale-like markings, such as those figured by Heer, in his "Fossile Flora der Baren Insel," which are represented lying close together. In the Tillicoultry specimen they are widely separated, and have beautiful filagree markings running lengthwise as well as transversely, thus separating them from each other. Mr Peach considered it to be *Lepidodendron Veltheimianum* of Goeppert, var. *reticulatum*. The normal form has been figured by the Geological Survey from Fife and East Lothian. The variety is new to Scotland, and has also been found by Mr D. Grieve near Colinton.

Mr Peach exhibited specimens of *Halonia* from various localities in Scotland, remarking, that though widespread it is not common, and little is known of this beautiful fossil plant. He exhibited a small but perfect specimen of *Favularia nodosa* of Bowman, showing impressions of leaves in the shale, which are not seen in Bowman's specimen. Mr Peach expressed his belief that a *Lepidodendron*, figured by Dawson, in his Fossil Plants from the Lower Carboniferous formations of Canada, as *L. corrugatum*, is not uncommon in shale at Colinton near Edinburgh, and other places. He concluded by mentioning that Mr Hodge

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of Dundee had given him a small but beautiful cone found in coal-shale at Wemyss, Fife, which did not correspond with any described species.

II. *Climatal Changes in Scotland.* By JAMES M'NAB, Curator, Royal Botanic Garden, Edinburgh.

Since my paper on Climatal Changes was read before the Society in November 1873, much discussion has taken place on the subject, and many of my opinions are endorsed by old Scottish gardeners, as well as by amateur cultivators. All maintain that many varieties of fruit now cultivated are not equal to what they were thirty to fifty years ago. The Ribston pippin and Nonpareil apples are alleged to be inferior in size and flavour, as well as in quantity, to the specimens formerly seen on walls, espalier rails, and standards. If seen good now, it is only on walls in very favourable situations, and during very fine summers. Walter Nicol, a great authority on Scottish horticulture, wrote in 1810 that the Ribston pippin will thrive and ripen at John o'Groats, while it deserves a place at Exeter and Cork. The Jargonelle pear is another fruit at one time extensively grown, and thoroughly ripened on standard trees in various districts in Scotland. Standard ripened Jargonelles are now exceedingly scarce, although during a fine summer a few are occasionally seen.

What has become of the boasted Carse of Gowrie orchards, which, half a century ago, were so remunerative to their proprietors? We find it recorded, from the years 1809 to 1813 inclusive, that seventy varieties of apples were then cultivated as standards in the Carse orchards, including Ribston pippin, Nonsuch, Yorkshire Greening, &c.; thirty-six varieties of standard pears, including Galston, Moorfowl egg, Swan egg, Jargonelle, &c.; eight varieties of plums, including white and red Magnum, Orleans, and Damson. The money produce of the thirty apple orchards alone, covering 126 acres, exclusive of the grains and grass frequently grown amongst them, from 1809 to 1813 inclusive, amounted to L.10,515. During 1809, the apples from the 126 acres yielded L.2318; 1810, L.2366; 1811, L.1840; 1812, L.2333; and 1813, L.1668, averaging from

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L.16 to L.20 per acre. These orchards still exist, and we learn that in some years apples are produced in considerable abundance, and in other years they are exceedingly scarce, but the average of any five consecutive years is greatly below what it was in former times.

About the same period the apple and pear orchards at Newburgh, in Fife, were productive and remunerative, and contained many excellent varieties. The French Reinette is particularly mentioned for its flavour. Standard pears were numerous, and some of great age. It is stated that the Jargonelle, Golden Knap, Swanton, and Lodge pears cannot have been less than three centuries old. (*Vide* Sir R. Sibbald, "Hist. of Fife," p. 403; and "Stat. Acct. Scot." ix. 62.) As far as I can learn, a heavy crop at Newburgh or Lindores has not been obtained for many years; partial crops are not unfrequent, but do not always ripen. The Clydesdale orchards half a century ago were a great source of profit to the proprietors, in consequence of the price obtained for the fruit in Glasgow. A letter before me, from an eminent horticulturist who has lived in that district for forty years, informs me that apples and pears of recent years have been on the decrease. The damson plum, which used to be abundant and productive in Clydesdale, has greatly failed, no proper crop having been got for a long time, and many of the trees are now rooted out. Gooseberries are, however, extensively grown.

The damson was formerly much cultivated in many parts of Scotland. About forty years ago I saw in Ayrshire trees bent down with ripe fruit. Such a sight I have not seen in Scotland, except in Ross-shire, for many years; but even there I am informed that heavy crops are only partial. The Ross-shire climate has always been considered one of the best north of the Tweed for ripening fruit, both wall and standard. Many plum orchards have recently been formed on the west coast, where the climate seems well suited for their growth; but instead of damsons, plants of the Victoria plum are most in demand.

The common black sloe of the plum tribe, indigenous to Scotland, used to ripen its fruit abundantly in many of our hedge-rows and mountain glens. I have not been fortunate enough to fall in with ripe fruit for many years,

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nothwithstanding the abundant crop annually produced. Although the bramble is frequently loaded with fruit, only a small proportion of the berries come to maturity, save in an exceptional season. The bramble is one of our hardiest native plants, and it is remarkable to observe the quantity of fruit produced and ripened along the English hedgerows in comparison with that found in a ripe condition in our best Scottish districts. The amount of fruit formed seems nearly the same, but a smaller percentage arrives at perfection.

A paper read before the Caledonian Horticultural Society in 1811, by that celebrated horticulturist Mr A. Gibson Hunter of Blackness, describes the fruits he observed during a tour in the Highlands of Scotland. He states that the Swan egg and Moorfowl egg, autumn Bergamot, Jargonelle, and other pears, produced on standards more regular and abundant crops, of superior flavour and well-ripened, although smaller than wall-grown fruit of the same kinds. He also states that the green-gage plum, the chief of its family, produces better crops, and of more excellent quality, when grown on standards than on the best exposed walls; and that standard trees of green gage, damson, and magnum bonum plums, in many parts of the Highlands, were often seen loaded with fruit; he particularly instances the gardens at Keppoch, parish of Kilmonivaig, in the south-west of Inverness-shire.

On consulting the minute-books and memoirs of the Caledonian Horticultural Society from 1810, we find that the chief fruit competitions took place early in September; amongst others, prizes were offered for peaches, sometimes as many as three sorts, six specimens of each, grown on open walls, without the aid of fire flues. Nectarines, apricots, and the finer plums were always well competed for, from all districts of Scotland. Some years as many as thirty competitors sent peaches, and all well-ripened open-air fruit; some besides, sent eleven named varieties thoroughly ripened, but marked for exhibition only. One year forty-seven competitors submitted apricots. After 1837 the prize for peaches from open walls "without the aid of fire-flues" was discontinued, the generality of the competition peaches sent in being grown on flued walls or

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in peach houses, to get them sufficiently matured for the first week of September, the competition for the two modes of ripening having previously been separate.

During the early horticultural exhibitions, the finer kinds of apples seem to have been more freely grown in Scotland than at present, as numerous passages in the horticultural memoirs testify. In 1813 and 1814, and occasionally down to 1824, excellent wall-grown specimens of the Newtown pippin apple were sent for competition from various gardens in Mid-Lothian. Dr Duncan, sen., in his discourse before the Caledonian Horticultural Society in 1814, says that he tasted as fine Newtown pippins grown on the open wall at Dalkeith Park, the seat of the Duke of Buccleuch, as the best imported from America. Such a remark, with reference to the Newtown pippin, is never heard now in Scotland. About 1815 we find it stated that two trees of the golden pippin at Pearton, in the parish of Ormiston, East Lothian, annually produced 100 to 120 dozen of large and highly-flavoured apples. The golden pippin is now rarely seen in Scotland, although it formed two of twelve sorts at most of the early fruit competitions.

The prize for the heaviest twelve Jargonelle pears from open walls, fit for dessert at first week of September, were freely competed for; but now it is often impossible to get heavy specimens fit for use at this season. Admirably grown specimens of French and Flemish pears used to be sent for competition from many districts of Scotland during the first week of December. It is rare now to see the same number of competitors as formerly, and the quality of the specimens now produced often compares unfavourably with those exhibited in bygone times. After a series of years we find those varieties produced at the meetings of the Society in March, not having been sufficiently matured to exhibit in December. Chaumontel and other sorts, originally produced at the December meetings, have been latterly exhibited in March. Now a competition for French and Flemish pears takes place in the first week in April. Although the fruits of many of the finer pears are produced in abundance, many of them shrivel up during the winter, their juices not being sufficiently matured, for want of summer heat, to enable them to keep properly.

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Cherries used to be freely grown and well-ripened in many districts of Scotland, but now, if the May Duke variety is ripe in July without artificial means, we are satisfied.

In 1814, and several successive years, ripe figs—early white black Genoa, the black and brown Ischia—were exhibited, the produce of the open walls at Ormiston, Tranent, where the fig trees bore freely for many years.

In 1814 a gooseberry competition was arranged in the Horticultural Society's rooms on August 2d, the general crop being always in July. During several of the early September meetings prizes were occasionally offered for retarded gooseberries, but few competitors came forward. In 1826 none were sent for competition, owing to the forwardness of that season. In 1849, and every year afterwards, gooseberries have been regularly competed for in September, without restrictions as to retarding, and now we find gooseberry competitions as late as September 17.

In Scotland the quince grows freely as a dwarf shrub, but very seldom produces fruit. About 1814 ripe Scotch-grown quinces were sent to the autumn horticultural exhibition, ripened in Perthshire. This was considered a very rare occurrence. A competition for quinces afterwards took place, and a prize was awarded for excellent specimens produced at Leuchie House, North Berwick.

In 1831 a prize was given for Scotch-grown American cranberries (*Vaccinium macrocarpum*). Of recent years the culture was attempted by the late Lord Murray in Argyleshire, but without success.

I doubt if even the filbert and hazel are as productive now, and ripen the nuts as well in Scotland as in former times. This will be better answered by those who have had nut plantations under their care for a series of years. As far as I have observed, they are not ripened as in olden times.

Nicol, in his "Gardener's Kalendar" for 1810, recommends that the seeds of tomatos be sown at the bottom of a wall in the open air with a south aspect, to have the fruit ripened to perfection. He also records the ripening of capsicums in the open border. In 1826, 1827, and 1828, prizes were offered for tomatos grown on open walls. The competition does not seem to have been general, not more than three

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competitors exhibiting at one time, and it was ultimately abandoned.

From 1810 to 1830, prizes were offered for home-made wines, particularly red and white currant, and gooseberry champagne; numerous competitors annually appeared, producing specimens which were much appreciated. In 1825, no less than 37 competitors exhibited currant wines, each sending two bottles. After 1834, prizes for home-made wines were discontinued, as the specimens did not come up to the mark, evidently from the want of heat to mature the saccharine juices of the currants.

From 1812 to 1826 the white poppy seems to have had field culture in various parts of Scotland, for making opium. In 1824 I recollect a field of the opium poppy (two acres in extent) cultivated at Tanfield, near Edinburgh. During August and September, women and girls were employed collecting the drug. About the same period fields of lettuce were grown in Scotland for making lactucarium. About 30 lbs. of the drug was made by one person in a year, and considered little inferior to the article produced in more favoured climates.

About fifty years ago tobacco was frequently grown in Scotland. The plants were generally strong and vigorous. The prepared leaves, although coarse, were employed with effect in killing greenfly in plant structures, as tobacco-paper is now used.

Several recent winters have been remarkable for their mildness, particularly 1873–4, many parties boasting of the bouquets which they have collected from their open gardens. The Gloire de Dijon and other roses have flowered freely on walls and in the open ground, and scarlet pelargoniums and other summer plants, bedded last spring, are still alive. The past winter and spring to this date (March 12) have produced more open-air flowering plants than any season known to me, showing that, if our summers are not so warm as formerly, our winters are much milder.

Some English meteorologists have been discussing the subject of climatal change, but I do not believe that any satisfactory opinion will be formed without consulting the records of English horticulture as to the ripening of fruits

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and plants in early times; even then, they, and the Scottish meteorologists should give details of the average temperatures of a certain number of summer months, say for ten years fifty or sixty years ago, and compare these with similar tables at the present time. My opinion is, that there is no difference in the average annual temperature now and in the olden times; but that we do not get the same intensity of heat in May, June, July, August, and September—the months when it is required to ripen the wood sufficiently to stand a severe winter, and prepare it for next year's flower and fruit. The same remark applies to many small shrubs standing in nurseries, which, when not sufficiently ripened by summer heat, are hurt by winter or spring frosts. It seems as if a proportion of the old summer temperature was now diffused, more or less, over the whole year.

In the *Revue Horticole*, M. Naudin, member of the Institute of France, in alluding to my views on the alleged change of climate in Scotland, says that a similar belief prevails in France. Arago, however, concludes that if such a deterioration has taken place, it is to an almost inappreciable extent—half a degree Centigrade in 1000 years.

III. *On Tea Cultivation in India, &c.*

1. Extract of letter from Surgeon-Major William Jameson, Director of the Botanic Garden, Saharunpore.

"The Dehra Doon Tea Company is prospering, and promises to become one of the best investments for money in India. In all good concerns, tea is giving dividends of 15 to 30 per cent. For years I recommended tea cultivation as a safe investment for capital. Parties now find that what I asserted was correct, and ere long I trust to see India a rival to China in supplying tea. The export from Calcutta to Europe will amount this season to upwards of 20,000,000 lb, and in addition a brisk trade with Central Asia is being opened up. Merchants from the Punjab, the factories in the Kangra Valley, Dehra Doon, Kumaon, and Gurhwal, buy up the teas, particularly green teas, at rates varying from 2s. to 2s. 6d. per lb., pack them in their

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own bags, and forward them to Peshawur for transmission to Cabul, &c. Tea promises to be one of India's greatest staples.

"Rhea fibre is under experiment, and the prize of L.5000 is still open to any one willing to furnish us with a machine to separate and clean it properly. I have forty acres of plants under cultivation, and am prepared to supply any quantity of stems for experimental purposes. In upper India, private enterprise scarcely exists. No one will take up a cultivation which involves risk, and therefore everything must be initiated by Government.

"The Spanish chestnut tree is succeeding admirably. There are three hundred trees from 20 to 35 feet in height, and many of them fruit freely. In Kumaon and Garhwal, the commissioner, Colonel Ramsay, is spreading the plant. Some day it will supply a great want. Sweet chestnuts now sell at 1 rupee or 2s. per lb. In seasons of scarcity, the seed of the horse chestnut is ground, and used by the Garhwallees and Kumaonees as food—bitter stuff. Many fruits are being extensively introduced and propagated, and India will ere long become a great fruit country. The railway is accomplishing this."

2. Extract of letter from William Bell, dated Dehra Doon, 25th November 1873.

"The tea making season is now closed, and we are getting the rain crop ready for the merchants. All the tea made in this district goes into Cabul and Bokhara. There is no expense for boxes or packing, the merchants take delivery at the factory. For the finer sorts we get 2s. 3d. per lb, and for the coarser 9d. to 1s. It is more satisfactory to have cash in hand before the tea leaves the factory, than to send it to England and wait four or six months before the sale returns come to hand, not to speak of the expense of packing and risk of damage in transit.

The past season has been trying: there were no winter rains, and from want of moisture at the roots a great portion of the bushes gave no spring crop at all. Then the weather was excessively hot, a powerful sun and hot dry winds scorched the tips and margins of the young leaves. They never expanded, but remained shrivelled and

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puckered, and made a bad quality of tea. My attention is specially directed to reduce the amount of coarse teas as far as possible. Although the past season was most unfavourable, the low class teas of 1873 are 25 to 30 per cent. less than in 1872."

IV. *Report on the Open-Air Vegetation at the Royal Botanic Garden, Edinburgh.* By JAMES M'NAB, Curator.

On February 12th I issued my first list of selected spring plants in flower. From the large number noticed at last meeting, I can only add eight to that list, viz.:—

	1874.	1873.
Narcissus pumilus . . .	Feb. 20	Mar. 14
Scilla bifolia, major . .	„ 28	„ 16
Erythronium Dens-canis . .	Mar. 1	„ 22
Scilla bifolia, alba . . .	„ 2	„ 28
Puschkinia scilloides . . .	„ 2	„ 22
Ribes sanguineum . . .	„ 3	„ 24
Scilla bifolia, rubra . . .	„ 3	„ 20
Muscari botryoides . . .	„ 8	April 5

Owing to the comparative mildness of February, many spring plants came into bloom besides those recorded in the selected list. I lay on the table 156 species and varieties of trees, shrubs, and herbs, picked in flower on March 10. Of these, ninety may be considered winter and spring species, the remaining sixty-one summer and autumn plants, whose flowering has been prolonged owing to the mild winter. The temperatures during the past month have been much the same as those noted on February 12. The thermometer was fourteen times at or below freezing point, exactly as in the previous month; the lowest markings being on the mornings of February 19, 20, and 23, and on March 10, 11, and 12—indicating respectively 27°, 26°, 25°, 26°, 22°, and 26°. During this period the highest morning temperatures were on February 14, 21, 22, and 27, and on March 5 and 8—indicating respectively 39°, 40°, 39°, 37°, 41°, and 41°. Vegetation is still about eighteen days in advance of last year, as may be seen above, though not so much as it was in February.

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V. *Miscellaneous Communications.*

1. Sir R. Christison, Bart., gave a description and measurements of a beech tree growing in front of Eccles House, Dumfriesshire, known as the "Eccles Beech." It stands in a row of very fine beeches, well detached from one another, with stems from 10 to 12 feet in girth, at 5 feet from the ground, of great elevation, and all most picturesque in the branching; but the "Eccles Beech" is 21 feet 4 inches in girth at the narrowest part of its trunk, and 105 feet in the diameter of its branch-spread. It is between 70 and 80 feet in height.

2. The following address of congratulation to H.R.H. The Duke of Edinburgh was adopted:—

"*To His Royal Highness the Duke of Edinburgh.*

"EDINBURGH, *9th April* 1874.

"May it please your Royal Highness, we, the President and Fellows of the Botanical Society of Edinburgh, of which your Royal Highness is an Honorary Fellow, approach your Royal Highness with the profoundest sentiments of respect and esteem.

"We congratulate your Royal Highness on the auspicious event of your Royal Highness' marriage with Her Imperial Highness the Grand Duchess Marie of Russia; and we pray that it may please Almighty God to bestow upon your Royal Highnesses long life, health, and every blessing.

"We earnestly pray that your Royal Highness may continue to enjoy the affection and regard of the people of the British Empire, and that the auspicious union with the illustrious House of Russia may be a source of comfort and satisfaction to Her Most Gracious Majesty the Queen.

"Finally, we beg to express a hope that your Royal Highness may be pleased to exert the powerful influence of your exalted station in fostering those peaceful arts and sciences, one of which it is our province to cultivate, which received so much of the countenance of your Royal Highness' illustrious father, whose memory is so truly and deservedly cherished by the British nation."

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Thursday, 9th April 1874.—Sir ROBERT CHRISTISON, Bart., President, in the Chair.

The following Candidates were elected:—

1. *Resident Fellows.*

JOHN STURGEON MACKAY, M.A.
C. H. MILLER.
JOHN PATERSON.

2. *Non-Resident Fellow.*

Surgeon-Major WILLIAM JAMESON, Saharunpore, India.

The following Communications were read:—

I. *On the Geographical Range of the Species, and varieties of Canadian Rubi, over the Continents of America, Asia, and Europe, as indicating possible regions of primitive distribution.* By GEORGE LAWSON, Professor of Chemistry, Dalhousie College, Halifax, Nova Scotia.

To the botanist some groups of the order *Rosaceæ* have a special interest, on account of their proneness to vary in the wild state, and the difficulty of determining what are really permanent species as distinguished from varieties. This is particularly the case with the European *Rubi fruticosi*, many of the long-recognised species of which are so closely related that some of our best botanists now rank upwards of twenty forms, too well-marked and too constant to be mere varieties, as so many "sub-species" under the specific type of *Rubus fruticosus*. But the European raspberry, *R. Idæus*, stands a solitary, isolated species, with no intimate relation to any of them, and no tendency to vary in their direction. In fact, the relatives and derivatives of this species are to be sought for out of Europe. It is spread over the north of Europe and Asia, as far as Manchooria and Japan, but is absent from the American continent. Here we have its representative *so-called species*, *R. strigosus*, our common American raspberry, while this and other Canadian species have their representatives in Eastern Asia. After elaborate investigation, Mr F. W. C. Areschoug believes that the European raspberry, as well as

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the N. American forms most closely related to it, grew primitively in Japan and adjacent countries.

The remarkable similarity between the flora of Eastern N. America and that of Eastern N. Asia had been prominently under notice by Prof. Asa Gray, long before its true significance, or the questions which it suggested, were fully appreciated by botanists. His views are—that our present vegetation in Eastern America, or its proximate ancestry, occupied the arctic or sub-arctic regions in Pliocene times; that plants of the same stock and kindred, forming a nearly uniform flora round the arctic zone (as uniform, perhaps, as our present arctic flora), made their forced migration southward upon widely different longitudes, and receded more or less as the climate grew warmer, and different associations of plants thus established themselves in regions suited to them, but not in any other. In the light of Prof. Gray's theory, and the special results obtained by Mr Areschoug, Prof. Lawson described the various species of *Rubus* inhabiting the Dominion, tracing their range on both sides of the Continent, and also in Asia, and pointing out the structural modifications they present. He regards *R. occidentalis*, *R. intermedius*, *R. Idæus*, with *Leesii* and its other European forms, and *R. strigosus* as all sub-species or subordinate forms of one specific type, distinct from, and not necessarily related in origin, but only in some points of structure, to other members of Areschoug's N. American type, which are in some respects widely different plants.

Details were given to show that *R. villosus* was a more southern species than *canadensis*. Northwardly the former decreases in vigour and in quantity, the northern and seaboard form looking like a different plant from the one growing in the interior, to the south of the great lakes. The long period required for ripening its fruit, the imperfect ripening of its canes in autumn, its sensitiveness to frost, its strong and rapid growth during summer, its villous foliage, its disappearance from exposed places when sheltering woods are removed,—all tell the same tale. *R. canadensis*, on the other hand, ripens its short, prostrate canes effectually, suffers not from winter's wind or weighty snows, yields its fruit abundantly and fully ripened early

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in the season, and every season has thin papery foliage, and maintains its ground in exposed places. The one is essentially the blackberry of Canada, and the other that of the United States. *R. triflorus* is more intimately related to the European *saxatilis* than is generally believed by botanists. *R. flaccidus* appears, from its observed constancy in Nova Scotia, entitled to rank as a sub-species of *R. hispidus*, which seems to have been originally a mountain species, rather than an arctic one.

R. Chamæmorus, although an arctic plant, and in Europe confined to the mountains of the north, abounds at the sea-level in Nova Scotia, producing the berries sold in the market under the name of "Bake Apple." Professor Lawson states that the present range of many so-called arctic plants in Europe cannot be regarded as coincident with their primeval range. A long period of civilisation has driven out many swamp plants, which now only exist in the sheltered recesses of the northern mountains, just as, year by year, on the American continent, the same or similar species are slowly meeting the same fate;—these are the remnants of a wider and more southern distribution in former times.

The effects of forest fires, of animal agencies, of railways, of lumbering, mining, and agricultural operations, in extending the distribution of some Rubi, and circumscribing that of others, were also referred to.

II. *List of the principal Trees and Shrubs of Northern India, with Synonyms.* By the late J. L. Stewart, M.D., F.L.S., F.G.S.

Order I.—DILLENIACEÆ.

1. Dillenia speciosa, *Thb.*—*Syn.* D. elliptica, *Thb.*; D. indica, *L.*
2. pentagyna, *Roxb.*—*Syn.* D. augusta, D. pilosa, *Roxb.*; Colbertia augusta, *Wall.*; C. coromandeliana, *DC.*
3. aurea, *Sm.*—*Syn.* D. ornata, *Wall.*

Order II.—MAGNOLIACEÆ.

4. Michelia Champaca, *Linn.*, tab. 1.*—*Syn.* M. aurantiaca, *Wall.*; M. Doltsopa, *Ham.*; M. rufinervis, *DC.*; M. Rheedei, *Wight*; M. pubinervia, *Blume.*

* See "Illustrations of the Forest Flora of North-West and Central India," by Brandis and Stewart. London, 1874.

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ORDER III.—ANONACEÆ.

5. Polyalthia longifolia, *Benth.* and *Hook. f.*—*Syn.* Uvaria longifolia, *Lam.* and *Roxb.* and *Vahl* (35 and 6442, Wall. Cat.); Guatteria longifolia, *Wall.;* Unona longifolia *Dunal.*; U. altissima, *Linn.* (Roxb., tab. 945, Bibl. Kew).
6. suberosa, *Bl.*—*Syn.* Guatteria suberosa, *Dunal.;* Uvaria suberosa, *Willd.*
7. Anona squamosa, *Linn.*
8. Miliusa velutina, *Hook. f.* and *Th.*, tab. 2.—*Syn.* Uvaria villosa, *Roxb.;* U. velutina, *Dun.;* Guatteria velutina, *A. DC.*
9. Saccopetalum longiflorum, *H. f.* and *Th.*

ORDER IV.—MENISPERMACEÆ.

10. Cocculus laurifolius, *DC.*—*Syn.* Menispermum laurifolium, *Roxb.*; Holopeira laurifolia, *Miers.*

ORDER V.—CAPPARIDEÆ.

11. Capparis aphylla, *Roth.*, tab. 3.—*Syn.* C. Sodada, *Br.;* Sodada decidua, *Forsk.*
12. spinosa, *L.*—*Syn* As of Dr T. Anderson in "Florula Adenensis," Lin. Soc. Jour., vol. v. Suppl. i. p. 5, including C. ægyptiaca, *Lam.;* C. obovata, *Royle* and *Dne.* in "Jacqt." Dr Anderson hardly ventures to join C. Murrayana, *Grah.*, C. galeata, *Fres.*, to this species, but it seems unquestionable that this union should be made.
13. horrida, *L. f.*—*Syn.* C. terniflora and quadriflora, *DC.;* C. zeylanica, *Willd.* in *Roxb.* (*non L.*); C. acuminata, *Wall.*
14. sepiaria, *L.*—*Syn.* C. incanescens, *DC.;* C. retusella, *Thw.*
15. Cratæva religiosa, *Forst.*—*Syn.* C. Roxburghii, *R. Br.;* C. odora, *Ham.;* Capparis trifoliata, *Roxb.;* C. religiosa, *Ham.;* C. unilocularis, *Ham.;* C. nurvala, *Ham.;* C. læta, *DC.;* C. odorata, *Ham.;* C. Roxburghii, *Br.*

ORDER VI.—BIXINEÆ.

16. Cochlospermum gossypium, *DC.*—*Syn.* Bombax gossypium, *L.;* Bombax gossypinum, *Willd.* in *Roxb.;* B. grandiflorum, *Sonn.* (Voy. 2 t. 133); B. conga, *Burm.* (Ind. 185).
17. Flacourtia sapida, *Roxb.*—*Syn.* F. austera, *Thw.;* F. Ramontchi, *L'Her.*, comes near this species, and has been united with it in "Bedd. Fl. Sylv."
18. Xylosma longifolium, *Clos.*, tab. 4.—*Syn.* Flacourtia cataphracta, *Roxb.* (Wall. Cat. 6674); F. stigmarota, *Wall.;* Ludia spinosa, *Roxb.* (*fide* Wall. Cat. 6678).

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ORDER VII.—PITTOSPOREÆ.

19. Pittosporum eriocarpum, *Royle.*—*Syn.* Solanum, *Wall. Cat.* 9074.
20. floribundum, *W.* and *A.*—*Syn.* P. zeylanicum, *Wt.* (*fide* "Bedd. Fl. Sylv."); Senacia nepalensis, *Loud.* and *DC.*; Celastrus nepalensis, *Steud.*; C. verticillata, *Roxb.*

ORDER VIII.—TAMARISCINEÆ.

21. Tamarix dioica, *Roxb.*, tab. 6.—*Syn.* T. articulata, *Wall.* (*non Vahl.*)
22. gallica, *L.*, tab. 5.—*Syn.* T. indica, *Willd.* and *Roem., MSS.* in Roxb.; T. senegalensis, *DC.*, and see synonyme in "Fl. Trop. Africa;" T. articulata, *Vahl.* and *Willd.* in Roxb.; T. chinensis, *Lour.* (*fide* Roxb. and Bge.); T. elegans, *Spach.*; T. laxa, *β* subspicata, *Ehr.* in Hb. Gay.; T. paniculata, *Stev.* in Hb. Gay.; T. anglica, *Webb.*; T. gallica, *var.* macrostemon, and *var.* tigrensis, *Bge.*
23. Pallasii, *Desv.* and *C. A. Meyer.*
24. orientalis, *Forsk.*, tab. 7.—*Syn.* T. articulata, *Vahl* and *DC.*; T. usneoides, *E. Mey.*
25. Myricaria germanica, *Desv.*, tab. 8.—*Syn.* Tamarix germanica, *L.*; M. bracteata, *Royle*; M. prostrata, *Hook. f.* and *Th.*, a variety of this equal = T. glacialis, *Jacqt. Voy.* grows at great elevations in the Himalaya, and is much dwarfed, with red-purple flowers; style and stigma of Myricaria, and sessile coma of Tamarix ("Gen. Plant").
26. elegans, *Royle.*—*Syn.* M. Hoffmeisteri, *Kl.*; M. germanica, *Desv., var.* longifolia, *Hb. Kew*; M. longifolia, *DC.*; M. linearifolia, *Desv.*

ORDER IX.—TERNSTRŒMIACEÆ.

27. Eurya japonica, *Thb.*—*Syn.* E. acuminata, *DC.*; E. ceylanica, *Wt.*; E. Wightiana fasciculata, *Wall.*; E. Roxburghii, *Wall.* Cat. 1463; E. tristyla, *W.* and *A.*; E. zeylanica, membranacea, elliptica, and parviflora, *Gard.*; E. multiflora, *DC.*; E. fluviatilis, *Champ.*; E. chinensis, *R. Br.*; Symplocos fasciculata, *Roxb. MSS.*, *fide* Wall. Cat. 1463.
28. Saurauja nepalensis, *DC.* (and *Roxb.*)—*Syn.* Ternstrœmia paniculata, *Hb. Wall.*; T. racemosa, *Don.*; Tonshia polypetalia and Dillenia racemosa, *Ham. MSS.*

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ORDER X.—DIPTEROCARPEÆ.

29. Shorea robusta, *Gært.*, tab. 9.—*Syn.* Vatica robusta, *Steud.*; Hopea floribunda, *Wall.* Cat.

ORDER XI.—MALVACEÆ.

30. Kydia calycina, *Roxb.*—*Syn.* K. fraterna, *Roxb.*; K. Roxburghii, *Wall.*; K. Roxburghiana, *Wt.*; K. Wightiana, *Miq.*
31. Adansonia digitata, *L.*—*Syn.* A. Baobab, *L.*; A. malabarica, *Pl.*
32. Bombax heptaphyllum, *Cav.*—*Syn.* B. malabaricum, *DC.*; B. insignis, *Wall.*, *Hb. Wt.*; Salmalia malabarica, *Endl.* and *Schott.* Our species was separated as Salmalia (from the chief native name), but the only difference from the American species of Bombax is, that in this the calyx often breaks up.

ORDER XII.—STERCULIACEÆ.

33. Sterculia villosa, *Roxb.*, tab. 10.
34. urens, *Willd.*—*Syn.* Cavallium urens, *Sch.* and *Endl.* Comes very near S. platanifolia, *L.*, but the leaves of latter quite smooth.
35. colorata, *Roxb.*—*Syn.* S. Wallichii, *Falc.*; S. fulgens, *Wall.* (Cat. 1135 in Hb. Kew); Firmiana colorata, *R. Br.*, *Horsf.*, and *Benn.*; Erythropsis Roxburghiana, *Lindl.*
36. Helicteres Isora, *L.*—*Syn.* H. chrysocalyx, *Miq.*; Isora corylifolia, *Sch.* and *Endl.*
27. Pterospermum acerifolium, *Willd.*, tab. 11.—*Syn.* Pentapetes acerifolia, *L.*; Velaga xylocarpa, *Adans.*
38. lanceæfolium, *Roxb.*—*Syn.* Samyda corymbosa, *Carey.*

ORDER XIII.—TILIACEÆ.

39. Grewia oppositifolia, *Ham.*, tab. 12.—*Syn.* G. subinæqualis, *DC.*, appears to be very near, or probably identical with this. (See No. 47.)
40. vestita, *Wall.*—*Syn.* G. elastica, *Royle.*
41. Rothii, *DC.*—*Syn.* G. pallida, *Horsh.*; G. salicifolia, *Stocks* in Hb. Kew; G. lævigata, *Heyne, fide* W. and A. (*non Vahl*, see No. 42); G. salvifolia, *Hb. Wt.*, and of *Roxb.*, *fide* W. and A., but Roxb.'s figure of G. salvifolia and G. salvifolia of Heyne are, according to my judgment, different from this; as is also G. bicolor, *Juss.*, which is united with this in the "Flora of Tropical Africa." Very near G. hirsuta, *Vahl*, which, however, has long hairs almost all over.

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42. Grewia lævigata, *Vahl.* (*non Heyne*, see No. 41.)—*Syn.* G. ovalifolia, *Juss.* (DC.); G. didyma, *Roxb.*, *fide* Wall. in Hb. Kew; G. oblonga and glabra, *Bl.*; G. lanceolata, *Miq.*; G. Damine, *Gært.*, *fide* DC., but see No. 43; and is held by some authorities as G. multiflora, *Juss.*, var.

43. salvifolia, *Heyne* in Roth.—*Syn.* G. excelsa, *Wall.*; G. Damine, *Gært.*, *fide* W. and A., but see No. 42. Is very near G. Rothii, No. 41, and also much resembles No. 44.

44. hirsuta, *Vahl.* (*non Roxb.*, for which see No. 46).—*Syn.* G. tomentosa and pilosa, *Roxb.*; G. salvifolia, *Hb. Roxb.*, and Wall. list; G. helicterifolia, *Wall.*; G. montana, *Kœn.*; G. Roxburghii, *Don.* Very near G. Rothii, *DC.*, No. 41, the chief obvious difference being that this has very long hairs almost all over.

45. pilosa, *Lam.* (*non Roxb.*, see No. 44).—*Syn.* G. orientalis, *Gært.*, *Vahl.*; G. carpinifolia, *Roxb.* (*non Juss.*); G. bipartita, *Hb. Roxb.*; G. dicarpa, *Roxb.* (*non Juss.*), *fide* Hb. Wt.; G. flavescens, *Juss.*; G. commutata, *DC.*; G. scabrida, *Wall.* Erroneously said in "Bedd. Fl. Sylv." to be equal to G. helicterifolia, *Wall.*, see No. 44.

46. polygama, *Roxb.*—*Syn.* G. lanceæfolia, *Griff.*; G. viminea, *Wall.*; G. hirsuta, *Roxb.* (*non Vahl*), *fide* Wall. Cat. 1090, and is near No. 41 and No. 44.

47. asiatica, *L.*—G. subinæqualis, *DC.*, much resembles this. (See No. 39).

48. tiliæfolia, *Vahl.*—*Syn.* G. arborea, *Roxb.*; G. variabilis, *Wall.*; Microcos lateriflora, *L.*, *fide* DC. Near G. vestita, *Wall.* (No. 40), which has smaller leaves and longer sepals. The statement in "Bedd. Fl. Sylv." at tab. 108, that is = G. elastica, *Royle*, is erroneous. (See No. 40).

Order XIV.—RUTACEÆ.

49. Zanthoxylum hostile, *Wall.*—*Syn.* Z. alatum and Z. armatum, *Roxb.*; Fagraea mollissima, *Wall.*; Fagara violacea, *Hb. Wall.* Very near Z. planispinum, *S.* and *Z.*

50. acanthopodium, *DC.*—*Syn.* Z. oxyphylla, *Edge.*

50. Limonia acidissima, *L.*—*Syn.* L. crenulata, *Roxb.*, Wall. Cat. 6364; L. ambigua, *Nutt.*

51. Murraya Kœnigii, *Spr.*—*Syn.* Bergera Kœnigii, *L.*

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52. Citrus aurantium, *L.* and *Risso*, Willd. in Roxb.—*Syn.* C. nobilis, *Lour.;* C. hystrix, *DC.* (see sub-sp. 52 *c.*); C. vulgaris, *Pers.* ("Bitter Orange"), generally with larger dimensions of leaves, parts of flowers, &c.
    Sub-sp. 52*a.* C. medica, *L.*
    52*b.* C. acida, *Roxb.*—*Syn.* C. acida, *Hort., var.* of C. medica, *L.*
    52*c.* C. Limetta, *Risso.*—*Syn.* C. hystrix, *DC.* (Spinous, *fide* W. and A., but see No. 52).
    52*d.* C. Bergamia, *Risso.*—*Syn.* C. Limetta, *var.* Bergiana, *Risso.*
    52*e.* C. Lumia, *Risso.*
    53*f.* C. Limonum, *Risso.*
53. decumana, *L.*, Willd. in Roxb.—*Syn.* Limo decumanus, *Rumph.*
54. Feronia elephantum, *Corr.*
55. Ægle marmelos, *Corr.*—*Syn.* Cratæva marmelos, *L., Willd.;* C. religiosa, *Ains.* (*non* Vahl.)

Order XV.—SIMARUBEÆ.

56. Picrasma quassioides, *Benn.*—*Syn.* Nima quassioides, *Ham. MSS.;* Simaba quassioides, *Don., fide* Benn.; Brucea nepalensis, *Wall.* in Hb. Kew. Very near P. nepalensis, *Benn.* of Nepal; the chief apparent difference being, that the latter has seven leaflets more longly acuminate.
57. Balanites ægyptiaca, *Delil.*—*Syn.* Ximenia ægyptiaca, *Juss.;* B. Roxburghii, *Pl. MSS.* in Bibl. Kew and Steud.

Order XVI.—BURSERACEÆ.

58. Boswellia serrata, *Roxb.*—*Syn.* B. glabra, *Roxb.* (glabrous form); B. thurifera, *Colebr.* There seems no doubt that the name here adopted should be that of the "three single species rolled into one;" as Colebrooke names it thus, as named and figured by Roxburgh in "Asiat. Research," vol. ix. p. 377, published 1809, and therefore the earliest notice of all; and to this Colebrooke again refers in "Trans. Lin. Soc." vol. xv. p. 363, published 1827; although Roxburgh, curiously enough, never gives this name except on Colebrooke's authority.
59. Garuga pinnata, *Roxb.*, tab. 13.—*Syn.* Boswellia pyxidata, *Hb. Wight, fide* Wall. Cat. 8485.

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60. Balsamodendron Berryi, *Arn.*—*Syn.* Amyris gileadensis, *Willd.*; Protium gileadense, *W.* and *A.* (excluding synonyms of both). The nomenclature and identity of this has been long much confused with B. gileadense, *Kth.* We follow Arnott, who is doubtless correct in separating it completely.
61. Mūkūl, *Hook.*—*Syn.* B. Roxburghii, *Sts.*; Protium Roxburghiana, *W.* and *A.*?
62. pubescens, *St.*—*Syn.* Protium pubescens, *W.* and *A.*?

Order XVII.—MELIACEÆ.

63. Melia azadirachta, *Linn.*—*Syn.* Azidirachta indica, *Juss.*
64. azedarach, *Linn.*—*Syn.* M. sempervirens, *Swartz.*; M. Candollei, *Juss.*; M. composita, *DC.* (*non* Willd., see No. 65); M. Bakayan, *Royle.*
65. Melia composita, *Willd.* (*non* DC., see No. 64).—*Syn.* M. robusta and superba, *Roxb.* in Hb. Kew; M. australis, *Sweet*; M. australasica, *Juss.*
66. Amoora Rohituka, *W.* and *A.*—*Syn.* Andersonia Rohituka, *Roxb.*, male plant; Sphærosacme Rohituka, *Wall.*; Hermaphrodite plant, S. spicata, *Wall.*; Meliacea Wightiana, *Hb. Wall.*; A. cucullata, *Roxb.*, differs from this chiefly by its less numerous spicate hermaphrodite and female flowers, and fewer stamens.
67. Heynea trijuga, *Roxb.* (*non* Wall., which is H. affinis, *Juss.*, *fide* W. and A.)
68. Soymida febrifuga, *Juss.*—*Syn.* Swietenia febrifuga, *Roxb.*; S. Soymida, *Dunc.*
69. Cedrela toona, *Roxb.*, tab. 14.—*Syn.* C. australis, *F. Müll.*; C. odora, *Lam.*?
70. serrata, *Royle.*—*Syn.* C. hexandra, *Wall.*, *fide* W. and A.
71. Chloroxylon Swietenia, *DC.*—*Syn.* Swietenia Chloroxylon, *Roxb.*

Order XVIII.—ILICINEÆ.

72. Ilex dipyrena, *Wall.*, tab. 15.
73. exsulca, *Wall.*—*Syn.* I. rotunda, *Thbg.* and *Don.*; I. elliptica, *Don.*; I. excelsa, *Auct.*? Cassine excelsa and Ehretia umbellulata, *Wall.*; Pseudehretia umbellulata, *Turcz.*; Prinos volumella, *Hb. Ham.*
74. odorata, *Ham.*

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ORDER XIX.—CELASTRINEÆ.

75. Euonymus Hamiltonianus, *Wall.*, tab. 16.—*Syn.* E. atropurpurea, *Willd.* (*non* Jacq.)
76. lacerus, *Ham.*—*Syn.* E. fimbriata, *Wall.*; E. grandiflorus, *Wall.*, is supposed by Royle (Ill. p. 167) to be identical with this species, but is probably E. tingens (see No. 78).
77. pendulus, *Wall.*—*Syn.* E. japonica, *Thbg.* (*non* Thb., *fide* W. and A.)
78. E. tingens, *Wall.*—*Syn.* E. grandiflorus, *Wall.*
79. echinatus, *Wall.*—*Syn.* E. vagans, *Wall.*; E. micranthus, *Don.*; E. scandens, *Grah.*
80. Celastrus spinosus, *Royle.*—*Syn.* C. edulis, *Vahl*; C. Royleana, *Hb. Royle.*; C. obscurus, *Ach. Rich.*; C. Schimperi, *Hochst.*
81. senegalensis, *Lam.*—*Syn.* C. phyllacanthus, *L'Her.*; C. montana, *Roxb.*; C. Heyneana, *Roth.*; C. montanus, *Wall.* Cat.; C. emarginatus, *Willd.*; C. emarginata, *Wall.*, *fide* W. and A.; C. Wallichiana, *Wall.* (*partim fide* W. and A.); C. cassinoides, *L'Her.*; C. serrulatus and C. crenata, *Roth.* (*non* Forst., *fide* W. and A.); C. coriaceus, *Guill.* and *Perr.*; C. decolor, *Caill. Delil.*; Catha montana, *G. Don.*; C. europæa, *Boiss.*; C. emarginata, *G. Don.*; Gymnosporia montana, *W.* and *A.*; Encentrus montanus, *Pl.*; Staphylea montana and vepretum, *Roxb.*; Zygophyllum dubium, *Hb. Falc.*
82. Elæodendron Roxburghii, *W.* and *A.*—*Syn.* E. glaucum, *Wall.* (*non* Pers. of Ceylon, which has a spherical drupe, &c.); E. paniculatum, *W.* and *A.*; Euonymus frigida, *Wall.* Cat.; Nerija dichotoma, *Roxb.*; Rhamnus nerija, *Spr.*; Schrebera albens, *Retz.?*

ORDER XX.—RHAMNEÆ.

83. Zizyphus vulgaris, *Lam.*—*Syn.* Z. flexuosa, *Wall.*; Z. nitida, *Roxb.*; Z. sinensis, *Lam.*; Rhamnus zizyphus, *L.*
84. oxyphylla, *Edgeworth.*—*Syn.* Z. acuminata, *Hb. Royle.* Differs from Z. vulgaris, chiefly in the blackish prickles, acuminate leaves, small drupe, and colour of the bark.
85. Lotus, *Lam.*—*Syn.* Rhamnus Lotus, *Linn.*; Zizyphus Spina Christi, *Willd.*, and Z. Jujuba, *var.* hysudrica of *Edgeworth*, Flora Mallica in "Linn. Soc. Jour." vi. 186; *Vern.* Bada or bara ber, "Trans. Indus and Afghanistan;"

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Ber, bera, pewandi (grafted), ber, *Pb.*; Z. Spina Christi has much whiter bark, frequent absence of spines, much larger cymes, much more tomentose inflorescence, including calyx, and frequency of hairs round base of style. Not uncommonly cultivated as single trees, and in groves —perhaps the most common of the cultivated Ber in some parts; all over the Punjab plains from Peshawar to Multan, and eastward to near the Jumna, in some places appearing to be wild or quasi wild. It is common about villages in North-Eastern Afghanistan, and reaches 3500 feet on the eastern skirts of the Suliman range, "Trans. Indus." It is found also in Persia, Arabia, Syria, in South Europe, and North Africa.

86. Zizyphus rugosa, *Lam.*—*Syn.* Z. latifolia, *Roxb.* and *Wall.* (*non* Hb. Ham., see No. 87); Z. obliqua, *Heyne*; Z. paniculata, *Hb. Mad.*; Rhamnus napeca, *Roxb.*; R. glabratus, *Heyne*. Is near Z. xylopyra (No. 89), but the latter is much more tomentose, and differs in fruit.

87. Jujuba, *Lam.*, tab. 17.—Wight Ic. t. 39; Beddome Fl. Sylv. t. 149.—*Syn.* Z. trinervia, *Roth.*; Z. mauritiana, *Wall.*; Z. latifolia, *Hb. Ham.* and *Wall.*, not Roxb., see No. 86; Z. hortensis, *Edgw.*; Z. abyssinica, *Hochst.*; Rhamnus Jujuba, *Linn.* *Vern.* Ber, bera, beri, North India; Ber, barakote, regu, renga, C. Prov. Commonly cultivated, especially where the Mussulman element prevails,—though nowhere certainly quite wild,—in East Afghanistan and in the Punjab to 3000 feet, and at times to 4500 feet in the outer Himalaya. Is certainly wild in some places of the Siwalik Forests east of the Ganges, and probably elsewhere. It is much cultivated in Sindh, Oudh, Bandalkhand, and in many parts throughout South India, and is also grown in Burma, Malacca, and Cochin China, in the Malayan Islands, the Moluccas, China, North Australia, Mauritius, and part of tropical Africa.

88. nummularia, *W.* and *A.*—*Syn.* Z. microphylla, *Roxb.*; Z. trinervia, *Roxb.* (*non Poir.*); Z. rotundifolia, *Lam.*; Z. glabrata, *Heyne* (unarmed); Rhamnus nummularia, *Burm.*; Rhamnus microphylla, *Roxb.*? Z. orthacantha, *DC.*, appears to come near this, but Hemsley, in the Flora of Trop. Africa, unites the former, from description with Z. Jujuba, *Lam.*; this, however, may well happen as hand specimens, especially from stunted individuals of Z. Jujuba, with reduced leaves, &c., and

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in the absence of fruit, are readily confused with the present species.

89. Zizyphus xylopyra, *Willd.* (*non Hochst.*, see No. 87).—*Syn.* Z. elliptica, *Roxb.*; Z. rotundifolia, *Roth.*; Z. caracutta, *Buch.*; Rhamnus xylopyrus, *Retz.*
90. Berchemia lineata, *DC.*—*Syn.* Rhamnus lineatus, *L.* and *Poir.*, and probably B. Poiretiana, *DC.*
91. Rhamnus purpureus, *Edgew.*, tab. 18.—*Syn.* R. cornifolia, *Boiss.* and *Hohen.*
92. triquetrus, *Wall.*—*Syn.* Ceanothus triquetra, *Wall.* in *Roxb.*; C. flavescens, *Royle MSS.*
93. virgatus, *Roxb.*—*Syn.* R. hirsuta, *W.* and *A.*
94. persica, *Boiss.* It appears doubtful if this species differs materially from R. oleoides, *L.* (of Asia Minor, Arabia, and S. Europe), the chief distinctions being that the latter is glabrous always, and has a larger fruit.
95. procumbens, *Edgew.*—*Syn.* R. rupestris, *Royle* (*non Scop. nec Vill.*) It seems to be possibly a mere form of R. persica, *Boiss.* (No. 94), but the specimens in Hb. Kew are few.
96. Hovenia dulcis, *Thbg.*—*Syn.* H. inæqualis, *DC.*; H. acerba, *Lindl.*
97. Sageretia oppositifolia, *Brongn.*—*Syn.* Zizyphus oppositifolia, *Wall.*; Berchemia(?) parviflora, *Wall.* (Cat. No. 4258); Rhamnus trigynus, *Don.*; R. parviflora, *Willd.*; R. filiformis, *Roth.*
98. Brandrethiana, *Aitch.*
99. theezans, *Bronyn.*—*Syn.* Rhamnus theezans, *Vahl.*; Berchemia hamosa, *Wall.*

Order XXI.—SAPINDACEÆ.

100. Æsculus indica, *Colebr.*, tab. 19.—*Syn.* Pavia indica, *Wall.*; Æs. assamica, *Griff.*, possibly. Is near Æs. panduana, *Wall.*
101. Schleichera trijuga, *Willd.*, tab. 20.—*Syn.* Melicocca trijuga, *Juss.*
102. Sapindus acuminatus, *Wall.*—*Syn.* S. detergens, *Roxb.*, *fide Wall.*
103. laurifolius, *Vahl* in DC., *Willd.* in Roxb.—*Syn.* S. trifoliata, *L.*; S. acutus, *Roxb.*, tab. 1965, in E. Ind. Co. Mus., *fide W.* and *A.*
104. Acer oblongum, *Wall.*—*Syn.* A. laurifolium, *Don.*; A. Buzimpala, *Ham. MSS.* Differs from No. 105, A. lævigatum, by entire, opaque, less reticulate leaves, glaucous below, and is a smaller tree, growing in much lower sites. A. niveum, *Bl.* (A. laurinum,

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Hassk. of Batavia), differs in its larger hexandrous flowers, and broad oval petals, &c.

105. Acer lævigatum, *Wall.*—*Syn.* A. reticulatum, *Champ.*

106. lætum, *C. A. Mey.*—*Syn.* A. cultratum, *Wall.*

107. cæsium, *Wall.*, tab. 21.—*Syn.* A. sterculiaceum, *Wall.* Near this is No. 108, A. villosum, the chief differences being that the leaves of the latter are much more pilose above, especially on the nerves, and very pilose under, and larger, broader, usually yellow-brown fruit and wing, the latter relatively broader, and having a few long hairs.

108. villosum, *Wall.* *See* No. 107 for differences.

109. caudatum, *Wall.*—*Syn.* A. acuminatum, *Don.* A. pectinatum, *Wall.*, in Hb. Kew, differs only in having much closer and sharper serrate leaves and smaller fruit; likely not to be fixed differences.

111. Dodonæa viscosa, *L.*—*Syn.* A. angustifolia and dioica, *Roxb.*; and D. Burmanniana, *DC.*, included in *var.* *a*, vulgaris, by Bentham ("Flora Austral." i. 476), the most common in tropical America, Africa, and Asia, the Pacific Islands, and tropical Australia.

112. Staphylea Emodi, *Wall.*

Order XXII.—SABIACEÆ.

113. Meliosma dilleniæfolia, *Bl.*—*Syn.* Millingtonia dilleniæfolia, *Wall.*

114. pungens, *Bl.*—*Syn.* Millingtonia pungens, and M. integrifolia, *Wall.*; M. simplicifolia, *Wall.* (*non Roxb.*); M. acuminata, *Royle*; M. congesta, *W.* and *A. MSS.*; M. rigidum, *Sieb.* and *Zucc.* of Japan and Loochoo, appears to be nearly identical with a long style.

Order XXIII.—ANACARDIACEÆ.

115. Rhus Cotinus, *L.*—*Syn.* R. lævis, *Willd.*; R. velutina and lævigata, *Wall.* (merely a rare, more glabrous form); R. pistaciæfolia, *Royle Hb.* in Hb. Kew.

116. parviflora, *Roxb.*

117. mysurensis, *Heyne.*—*Syn.* R. indicum, *Hb. Mad.*, is very near, and may not be specifically distinct from No. 116; Amyris spinosa, *Hb. Mad.*; *fide* Wall. Cat. 997.

118. semialata, *Murr.*—*Syn.* R. Buckiamela, *Roxb.*; R. amella, *Don.*; R. javanica, *L.*; R. javanicum, *Lour.*

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119. R. succedanea, *L.*—*Syn.* R. vernix, *Hort. Beng.; fide* Wall. Cat. 992 (*non L.*, see No. 120); R. acuminata, *DC.*, "often fewer, 7–9 leaflets, and more marked secondary veins;" R. succedanea, *β*, discolor, *Hassk.;* Connarus juglandifolius, *Hook.* and *Arn.*
120. R. vernicifera, *DC.*—*Syn.* R. vernia, *Linn.* and *Thunb.*, not *Hort. Beng.* (see No. 119); R. juglandifolia, *Wall.* and *Don.*, not *Willd.*
122. Pistacia integerrima, *J. L. Stewart*, tab. 22.—*Syn.* Rhus integerrima, *Wall.* Cat. 8474; R. acuminata, *Hb.*, and Kakrasinghee, *Royle.*
123. terebinthus, *L.*—*Syn.* P. Khinjuk, *Stocks.*
124. atlantica, *Desf.*—*Syn.* P. cabulica, *Stocks.*
125. Mangifera indica, *L.*—*Syn.* M. sylvatica, *Roxb.;* M. amba, *Forsk.*
126. Buchanania latifolia, *Roxb.*—*Syn.* B. angustifolia and tomentosa, *Hb. Ham.* (*fide* Wall. Cat. 983); Mangifera sylvatica, *Koen.* in Roxb.; Spondias elliptica, *Rottb.*, *Hb. Wt.* in Hb. Kew.
127. Odina Wodier, *Roxb.*—*Syn.* O. pinnata, *Hb. Wt.;* Rhus odina, *Hb. Ham.* Near O. Schimperi, *Hochst.* of tropical Africa.
128. Semecarpus Anacardium, *L.*—*Syn.* S. latifolium, *Pers.;* S. cuneifolium, *Roxb.* and *Wall.;* Anacardium latifolium and longifolium, *Lam.*
129. Spondias mangifera, *Pers.*—*Syn.* S. paniculata, *Hb. Roxb.*, probably S. acuminata, *Roxb.*, with usually smaller leaves, panicles, and fruit; S. amara, *Lam.* and *Hb. Ham.* (*fide* Wall. Cat. 8476); Mangifera pinnata, *L. fil.* (*non Lam.*); Baldingera glandulosa, *Dennst.;* Evia amara, *Comm.;* Poupartia mangifera, *Bl.*

Order XXIV.—MORINGEÆ.

130. Moringa pterygosperma, *Gœrt.*—*Syn.* M. oleifera, *Lam.;* M. zeylanica, *Pers.;* Guilandina Moringa, *L.;* Hyperanthera Moringa, *Vahl.*
131. concanensis, *Nimmo.* Beddome ("Flor. Sylv.") believes this may be a *var.* only of No. 130.

Order XXV.—LEGUMINOSÆ.

132. Ougeinia dalbergioides, *Benth.*, tab. 23.—*Syn.* Dalbergia ougeinensis, *Roxb.*
133. Erythrina suberosa, *Roxb.*—*Syn.* E. alba, *Roxb.*

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134. Erythrina arborescens, *Roxb.*
135. indica, *Lam.*—*Syn.* E. corallodendron, *β*, *L.*; E. orientalis, *Murr.*
136. Butea frondosa, *Roxb.*—*Syn.* Erythrina monosperma, *Lam.*
137. Dalbergia latifolia, *Roxb.*—*Syn.* D. emarginata, *Roxb.*; D. Sissoides, *Grah.*
138. Sissoo, *Roxb.*, tab. 24.—*Syn.* D. pendula, *Ten.*
139. paniculata, *Roxb.*—*Syn.* D. multiflora, *Hb. Heyne.*
140. lanceolaria, *L.*—*Syn.* D. frondosa, *Roxb.*; D. zeylanica, *Roxb.* (*fide* Wall. Cat. 5847); D. arborea, *Heyne* in DC. (*non Willd.*, which is Pongamia glabra, see No. 145); D. hircina, No. 141, is near this, but its leaflets are much longer, lowest calyx-lobe obtuse, &c.
141. hircina, *Ham.* Very near No. 140.
142. volubilis, *Roxb.* Very near No. 141.
143. rimosa, *Roxb.* Very near D. variabilis, *L.*, of tropical America.
144. Pterocarpus marsupium, *Roxb.*—*Syn.* P. bilobus, *Roxb.*
145. Pongamia glabra, *Vent.*—*Syn.* P. grandifolia, *Zoll.* and *Mer.*; Dalbergia arborea, *Willd.* in Roxb. (*non Heyne*, see No. 140); Dolichos arborea, *Roxb.*; Galedupa indica, *Lam.* in Roxb.; Robinia mitis, *L.* in Roxb.
146. Poinciana regia, *Bojer.*
147. Cassia fistula, *L.*—*Syn.* C. rhombifolia, *Roxb.*; Cathartocarpus fistula, *Pers.*
148. Bauhinia variegata, *L.*—*Syn.* B. candida, *Roxb.*; Phanera variegata, *Benth.*
149. purpurea, *L.*—*Syn.* B. triandra, *Roxb.*; B. coromandeliana, *DC.*; Phanera purpurea, *Benth.*
150. retusa, *Roxb.*—*Syn.* B. emarginata, *Roxb.*, *fide* Wall. Cat. 5792, *Hb. Ham.* and *Royle Ill.* (*non Jack*); Phanera retusa, *Benth.*
151. racemosa, *Roxb.*—*Syn.* B. parviflora, *Vahl.*; B. spicata, *L.* and *Koen.*; Pileostigma racemosa, *Benth.* in Hb. Kew.
152. malabarica, *Roxb.* Much resembles B. racemosa, but has much larger leaves, with large black glands above base, smaller longitudinal reticulate venation, and always rusty tomentose outside calyx.—*Syn.* B. bacuria, *Hb. Ham.*; B. tomentosa, *Hb. Wall.*; B. reniformis, *Hb. Royle*; Pileostigma malabarica, *Benth.* in Hb. Kew.
153. Tamarindus indica, *L.*—*Syn.* T. officinalis, *Hook.*
154. Hardwickia binata, *Roxb.*—*Syn.* H. trapeziformis, *Griff.*;

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Bauhinia ecalyculata, *Heyne.* H. pinnata, *Roxb.*, is very near this as to structure of flower, but has three pairs of opposite(?) or alternate, ovate-lanceolate, acuminate, one-nerved leaflets, and a smaller flower. Was collected in Travancore (*fide* Wallich's specimens in Hb. Kew), but Beddome states he has never seen it. There may have been some mistake as to the locality.

156. Prosopis Stephaniana. *Kunth.*—*Syn.* Lagonychium Stephanianum and Acacia Stephaniana, *Bieb.*; M. micrantha, *Vahl;* M. agrestis, *Sieb.*

157. spicigera, *L.*, tab. 25.—*Syn.* P. aculeata, *Koen.* (*fide* Roxb.); Adenanthera aculeata, *Roxb.*

158. Acacia arabica, *Willd.*—*Syn.* Mimosa arabica, *Lam.*; A. nilotica, *Delil.* (glabrous fruited); A. vera, *Willd.*

159. leucophlœa, *Willd*, tab. 27.—*Syn.* A. alba, *Willd.*; A. microcephala, *Grah.* (*fide* Wall. Cat. 5263); Mimosa leucophlœa, *Roxb.*

160. eburnea, *Willd.*—*Syn.* Mimosa eburnea, *L.*

161. Jacquemonti, *Benth.*

162. modesta, *Wall.*—*Syn.* Mimosa obovata, *Roxb.*; M. dimidiata, from Bengal, in Hb. Kew.

163. lenticularis, *Ham.*—*Syn.* Desmanthus Adenanthera, *Hb. Royle.*

164. A. Catechu, *Willd.*, Bedd. "Fl. Sylv." t. 49.—*Syn.* A. polyacantha, *Willd.*, and A. Wallichiana, *DC.*; Mimosa Catechu, *Linn. fil.*, Roxb. Cor. Pl. t. 175; M. suma, *Roxb. Vern.* Khair, kheir, kher, chiefly differs from A. sundra, *DC.*, by softly pulverulous young parts, and more numerous pinnæ and leaflets. A variety (probably) is A. catechuoides, *Benth.*; (Mimosa catechuoides, *Roxb.*)

165. A. Sundra, *DC.*, Bedd. "Fl. Sylv.," t. 50.—*Syn.* A. Chandra, *Willd.*; A. suma, *Hb. Ham.*; Mimosa Sundra, *Roxb.*, Cor. Pl. t. 225. *Vern.* Gan khaira, gharra khair, sundra, C. P.

166. Albizzia Lebbek, *Benth.*—*Syn.* A. latifolia, *Boiv.*; Acacia Lebbek and A. speciosa, *Willd.*; A. Sirissa, *Ham.*; A. macrophylla, *Boge.* (China in Hb. Kew); Mimosa Lebbeck, *L.*; M. Sirissa, *Roxb.*; M. speciosa, *Jacq.*; M. flexuosa, *Rottl.*; Inga bourbonica and I. leucoxylon, *Hassk.*

167. odoratissima, *Benth.*—*Syn.* A. micrantha, *Bonc.*; Acacia

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odoratissima, *Willd.*; A. similis, *Zoll.*; Mimosa odoratissima, *L.*

168. Albizzia procera, *Benth.*, tab. 26.—*Syn.* Acacia procera, *Willd.*; A. elata, *Grah.*; Mimosa procera, *Roxb.*; M. coriacea, *Blanco*; Inga gracilis, *Jungh. MSS.*

169. Julibrissin, *Boiv.*—*Syn.* Acacia Julibrissin, *Willd.*; A. Nemu, *Willd.*; Mimosa Julibrissin, *Scop.*; M. arborea, *Forsk.*; *var.* α, mollis—the common N.W. Himalaya form, with softly pubescent leaflets, &c., and flowers.—*Syn.* Acacia mollis, *Wall. Cat.* 5235; A. isembergiana, *Schimp.*; Albizzia mollis, *Boiv.* Is near A. Lebbek (No. 166), but leaves are very different, and flowers and pods differ considerably.

170. stipulata, *Boiv.*—*Syn.* Acacia marginata, *Ham.*; A. Smithiana, *Wall.*; A. stipulata, *DC.*; Mimosa Smithiana and M. stipulacea, *Roxb.*; Inga umbraculiformis, *Jungh. MSS.*; I. purpurascens, *Bl.*; Arthrosprion stipulata, *Hassk.*

171. Pithecolobium dulce, *Benth.*—*Syn.* Mimosa dulcis, *Roxb.*; M. unguis Cati, *Blanco*; Inga dulcis, *Willd.*; I. javana, *DC.?*

Order XXVI.—ROSACEÆ.

172. Prunus amygdalus, *L.*—*Syn.* Amygdalus communis, *L.*

173. incana, *Stev.*—*Syn.* Amygdalus incana, *Pall.*

174. armeniaca, *L.*

175. dasycarpa, *Ehrh.*—*Syn.* P. armeniaca nigra, *Desf.*; Armeniaca dasycarpa, *DC.*; A. atropurpurea, *Lois.*; Amygdalus dasycarpa, *Pers.*

176. persica, *L.*—*Syn.* P. vulgaris, *L.* (*?*); Amygdalus persica, *L.*; A. collinus, *Wall.*; Persica vulgaris, *Mill.*; *var.* lævis.—*Syn.* Amygdalus persica, *Lam.*; A. persica nectarina, *Ait.*; Persica lævis, *DC.*

177. institia, *L.*—*Syn.* P. domestica, *L.*; P. spinosa, *L.*

178. japonica, *Thunbg.*—*Syn.* P humilis, *Bge.* (*non Moris.*); P. Bungei, *Walp.*; P. microcarpa, *C. A. Mey*; P. sinensis, *Pers.*; Cerasus japonica, *Lois.*; Amygdalus pumila, *L.*, Hort. Kew (*nec tamen, L., fide* Lindl.); A. humilis, *Edgew.*, who states that it differs from A. nana, *L.*, chiefly in its broader leaves, longer calyx tube, and shorter petals.

179. cerasus, *L.*—*Syn.* P. cerasus avium, *L.*; P. avium, *Willd.*; P. nigra, *Mill.*; P. caproniana, *Gaud.*; P. austera, *Ehr.*; P. collina, *Lipp.*; Cerasus avium, *Mœnch.*;

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C. caproniana, *DC.* (*?*) and C. ariflorum, *DC.* (*?*); C. acida, *Endl.*; C. tomentosa, *Wall.*, found at 5000 to 6000 feet in Kashmir, with deeply, broadly serrate, and soft pilose leaves, and large fruit; seems near or identical with this, but there are not sufficient materials in Hb. Kew to settle the point; *var.* Mahaleb, *L.*—*Syn.* P. odorata, *Lam.*; P. Marasca, *Rchb.*; Padus Mahalib, *Borckh.*; Cerasus mahalib, *Lois.*; C. Marasca, *Host.*; C. Fontanesiana, *Spach.*; C. cupaniana, *Guss.*

180. Prunus Puddum, *Roxb.*—*Syn.* P. cerasoides, *Don.*; P. sylvatica, *Roxb.*, Hort. Beng.; P. pseudo-cerasus, *Steud.*; Cerasus Puddum, *Roxb.* ex. *Wall.* in DC.; C. Phosia, *Ham.*

181. prostrata, *Labill.*—*Syn.* P. austera, *Rchb.*; P. incana, *Stev. fide Steud.* (*sed non*); Amygdalus prostrata, *Sweet*; A. nana *var.* incana, *Loud.*, Arb. Hort. Brit.; Cerasus prostrata, *Ser.*; C. humilis, *Moris.*

182. Padus, *L.*—*Syn.* Cerasus Padus, *DC.*; C. cornuta, *Wall.*

183. capricida, *Wall.*—*Syn.*—P. adenophylla, *Wall.*; P. undulata and P. incana, *Ham.*; Cerasus capricida, *Wall.*; C. undulata, *Ser.*

184. Pyrus variolosa, *Wall.*—*Syn.*—P. Pashia, *Don.* Is noted as near P. granulosa, *Bert.*

185. communis, *L.*

186. Malus, *L.*, Indian form.

187. baccata, *L.*—*Syn.* P. macrocarpa, *Wendl.* and *Mœnch.*; Malus baccata, *Desf.*; M. sibirica, *Borckh.*; Mespilus baccata, *Dum.*

188. Aria, *Ehrh.*, Indian form.—*Syn.* P. kumaonensis and P. vestita, *Wall.*; P. crenata and P. lanata, *Don.*; Cratægus Aria, *L.*

189. foliolosa, *Wall.*—Near P. Aria, and very near P. Sorbus, *L.*; has leaves usually entire, at times serrate, small flowers and white, sweet fruit.

190. ursina, *Wall.*—*Syn.* P. microphylla, *Wall.*, of Sikkim, 11,000 to 14,000 feet, "red flowers, largish fruit," seems very near if not identical with this. The chief evident difference of this from P. aucuparia, *L.*, is that the petals of the latter are glabrous from the first.

191. Cratægus pyracantha, *Pers.*—*Syn.* C. crenulata, *Roxb.* and *Lindl.*; Mespilus pyracantha, *L.*; M. crenulata, *Don.*

192. oxyacantha, *L.*—*Syn.*—Mespilus oxyacantha, *Gært.*

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193. Stranvæsia glaucescens, *Lindl.*—*Syn.* Cratægus glauca, *Wall. Cat.* 673; Pyrus Nussia, *Don;* Photinia dubia (?) *Madd.* Jour. As. Soc., 1848, p. 365.

ORDER XXVII.—HAMAMELIDEÆ.

194. Parrotia Jacquemontiana, *Decaisne*, tab. 28.—*Syn.* Fothergilla involucrata, *Falc.* This, by some, considered identical with P. persica, *C. A. Mey.* of Persia, but although there are not materials in Hb. Kew sufficient to enable the flowers of the latter to be compared, there seems to be sufficient ground for keeping them specifically distinct in these facts. Of P. persica, the leaves are cuneate based, long oval acuminate, thin, membranous, entire to half-way from base, and beyond with mucronate crenatures, and with narrow (not broad), flattened nerves, shining above, under brownish and much less villous; calyx lobes are broad, anthers twisted and long acuminate, and the fruit smaller than in P. Jacquemontiana.

ORDER XXVIII.—RHIZOPHOREÆ.*

195. Rhizophora mucronata, *Lam.*—*Syn.* R. Mangle, *Roxb.* (*non* L.); R. candelaria, *Wall.* and *W.* and *A.*

196. Ceriops Candolleana, *Arn.*—*Syn.* Rhizophora timorensis, *DC.;* Bruguiera Arnottiana, *Wt. MSS.*

197. Bruguiera Rheedii, *Bl.*—*Syn.* B. gymnorrhiza, *Lam.;* B. Rumphii and B. Wightii, *Bl.;* B. australis, *A. Cunn.*

ORDER XXIX.—COMBRETACEÆ.

198. Terminalia Bellerica, *Roxb.*—*Syn.* T. punctata, *Roth.;* Myrobalanus Bellirica, *Gært.*

199. Chebula, *Retz.*, tab. 29.—*Syn.* T. citrina, *Roxb.;* T. reticulata, *Roth.;* Myrobalanus chebula and M. citrina, *Gært.*

200. tomentosa, *W.* and *A.*—*Syn.* T. crenulata, glabra, and coriacea, *W.* and *A.;* T. alata, *Roth.;* Pentaptera tomentosa, crenulata, glabra, and coriacea, *Roxb.* All the species now amalgamated here were founded on minor and variable differences. Near T. paniculata, *Roth.*, but its leaves always smaller, narrower, and entire, often without glands near base; calyx always pilose both sides, and fruit—mostly (?) with one large and two small wings.

* These occur in the tidal creeks of the Indus.

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201. Terminalia Arjuna, *W.* and *A.*—*Syn.* T. Berryi, *W.* and *A.* (Beddome cannot distinguish any specific difference); Pentaptera Arjuna and angustifolia, *Roxb.*
202. Anogeissus latifolia, *Wall.* — *Syn.* Conocarpus latifolia and Andersonia altissima, *Roxb.*, *var.* sericea.
203. acuminata, *Wall.*—*Syn.* Conocarpus acuminata, *Roxb.* and *Hb. Ham.* (*fide* Wall. Cat.); C. lanceolata, *Hb. Heyne.* (*fide* Wall. Cat.); Andersonia acuminata, *Hb. Roxb.*; A. lanceolata, *Roxb.* and *Ham.*; A. alternifolia and A. altissima, *Hb. Wt.* Conocarpus parvifolia, *Hochst.*, with somewhat larger fruit, is probably identical with this.
204. pendula, *Edgew.*—*Syn.* A. angustifolia, *Edgew.*; Conocarpus myrtifolia, *Royle.*

Order XXX.—MYRTACEÆ.

205. Eugenia Jambos, *L.*—*Syn.* Jambosa vulgaris, *DC.*; Myrtus Jambos, *H.B.K.*
206. Jambolana, *Lam.*, tab. 30.—*Syn.* E. obtusifolia and E. fruticosa, *Roxb.* (the latter shrubby, with shorter, broader leaves); E. frondosa, *Hb. Wall.*; E. caryophyllacea, probably E. Jambolana, *var.* microphylla, *Wt. Icon.* t. 535; Syzygium Jambolanum, *DC.*, with oblong lanceolate leaves; E. laterifolium, *Hb. Royle*; Calyptranthes Jambolana, *Willd.*
207. operculata, *Roxb.*—*Syn.* E. paniala, *Roxb.*, probably; E. cerasoides, *Roxb.*, probably; but hardly materials sufficient in Hb. Kew to determine this; E. obovata, *Wall.*, with more marked calyx on fruit; Syzygium nervosum, *DC.*; S. nodosum, costatum, and ancolanum, *Miq.*; Calyptranthus mangiferifolia, *Hance*; C. Jambolana, *Willd* (?) Very near E. Jambolana in habit, &c., but distinguishable by shape and nerves of leaves, inflorescence, and minor marks.
208. Barringtonia acutangula, *Gært.*—*Syn.* Eugenia acuta, *L.*; E. racemosa, *Roxb.*; Stravadium album, *Pers.*; S. rubrum and S. coccinium, *DC.*; Stravadia rubra, *Pers.*; Meteorus coccineus, *Lour.*
209. Careya arborea, *Roxb.*, *var.* australis, *Benth.*, may possibly be distinct, as it has much smaller leaves, pedicellate flowers, only ten to twelve ovules in cells, and fruit broad ovoid; but "in Hb. Kew specimens from Australia are very fragmentary." (*Benth.*)

Order XXXI.—LYTHRARIEÆ.

210. Lagerstrœmia parviflora, *Roxb.*—*Syn.* Fatioa nepaulensis, *DC.*
211. Punica granatum, *L.*—*Syn.* P. nana, *L.*

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ORDER XXXII.—SAMYDACEÆ.

212. Casearia tomentosa, *Roxb.*, tab. 31.—*Syn.* C. ovata, *Roxb.* (*vix* Willd.); C. glabra, *Roxb.* (*teste* Benth.); C. elliptica, *W.* and *A.* (*vix* Willd.); C. villosa, fragilis, and glomerata, *Hb. Wt.*; Samyda Canziala, *Wall. Hb. Ham.* Is very near C. sub-cuneata, *Miq.*, of Java, the chief conspicuous difference being that the latter has semi-cordate broad-based leaves.

213. graveolens, *Dalz.*—*Syn.* C. Hamiltonii, *Wall.* (in Hb. Royle.)

ORDER XXXIII.—CORNACEÆ.

214. Alangium hexapetalum, *L.*—*Syn.* A. decapetalum and tomentosum, *Lam.*; A. Lamarckii, *Thw.*; A. latifolium, *Miq.*; Grewia salvifolia, *L.*; G. montana, *Koen.*

215. Marlea begoniæfolia, *Roxb.*—*Syn.* M. affinis, *Dcne.*; M. macrophylla, *Sieb.* and *Zucc.*; Diacæcarpium rotundifolium, *Hassk.*; Stylidium chinense, *Lour.*; Stylis chinensis, *Poir.*, *fide* D.C.

216. Cornus macrophylla, *Wall.*, tab. 32.—*Syn.* C. brachypoda, *C. A. Mey.*; C. alba, *Thbg.* Near C. alba, *L.* (of Siberia and N. America), but flowers larger and petals longer.

217. sanguinea, *L.* (Indian form). Very near C. mascula, *L.* (of Europe), chief conspicuous difference being in leaves of latter, which are oval, acuminate, rather pubescent on both sides.

218. oblonga, *Wall.*—*Syn.* C. paniculata, *Ham.*

219. capitata, *Wall.*—*Syn.* Benthamia fragifera, *Lindl.*

ORDER XXXIV.—RUBIACEÆ.

220. Nauclea Cadamba, *Roxb.* (*non* Wall., which is N. purpurea, *Roxb. fide* W. and A.)—*Syn.* N. citrifolia, *Poir.*; N. orientalis, *L.*, partly; N. parvifolia, *Roxb.*, partly (*fide* Thw.) and Roxb. on fig.; Cephalanthus orientalis, *L.*; Anthocephalus Cadamba, *A. Rich.* in Hb. Kew; N. purpurea, *W.* and *A.* (*fide* Wall.; and Dalz. in Bombay Flora, probably identical, the chief apparent difference being that the leaves are longer and narrower, especially at base.

221 parvifolia, *Roxb.*—*Syn.* N. parviflora, *Pers.*; N. orientalis, *L.* (partly N. Cadamba, *Roxb.*, *fide* Thw.); N. sterculiæfolia, *A. Rich.* (*fide* DC. *sed non*, *vide* No.

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223); Cephalanthus pilulifer, *Lam.;* Stephegyne parvifolia, *Korth.* (in Hb. Kew); Mitregyne parviflora, *Korth.*

222. Nauclea cordifolia, *Roxb.*, tab. 33.—*Syn.* N. sterculiæfolia, *A. Rich.;* Adina cordifolia, *Korth.*

223. Hymenodictyon excelsum, *Wall.*—*Syn.* H. thyrsiflorum, *Wall.;* Cinchona excelsa and C. thyrsiflorum, *Roxb.*, very near H. Horsfieldii, *Miq.*, of Java.

224. flaccidum, *Wall.*—*Syn.* H. acuminatum, *Falc. MSS.* in Hb. Kew; Cinchona excelsa, *Hb. Ham.*

225. Gardenia latifolia, *Ait.* (*non* Gært.)—*Syn.* G. enneandra, *Kœn.*, *fide* Wt. Icon.

226. lucida, *Roxb.*—*Syn.* G. resinifera, *Roth.*

227. gummifera, *L.*—*Syn.* G. arborea, *Roxb.*, *fide* W. and A.; G. inermis, *Dietr.*

228. turgida, *Roxb.* Near and may be identical with G. montana, *Roxb.*, but there are not sufficient materials at my command to settle this.

229. Randia dumetorum, *Lam.*—*Syn.* R. longispina, *DC.;* R. spinosa, *Bl.;* Gardenia spinosa, *L.* and *Thbg.;* G. dumetorum, *Willd.* and *Retz.;* Posoquiera longispina and P. dumetorum, *Roxb.;* Canthium coronatum, *Lam.*

230. uliginosa, *DC.*—*Syn.* Gardenia uliginosa, *Willd.* and *Retz.;* Posoquiera uliginosa, *Roxb.*

231. Hyptianthera stricta, *W.* and *A.*—*Syn.* Randia stricta, *Roxb.;* Macroneuron strictum, *Roxb.*, Ill. in Bibl. Kew.; Rondeletia stricta, *Roth.*, *fide* Wall. in Roxb.

232. Morinda exserta, *Roxb.*—*Syn.* M. tinctoria, *Roxb.* (with narrow leaves); M. nodosa, *Ham.;* M. chachuca, *Hb. Ham.;* M. aspera, *W* and *A.*, "probably only a mere variety," *Hook. fil.*

233. citrifolia, *L.*

Order XXXV.—ERICACEÆ.

234. Pieris ovalifolia, *Don.*—*Syn.* Andromeda ovalifolia and A. lanceolata, *Wall.;* A. capricida, *Ham.;* A. squamulosa, *Don;* A. elliptica, *Sieb.* and *Zucc.;* A. japonica, *Thbg.*; P. villosa, *Don* (A. villosa, *Wall. Cat.*) is very near this, the most evident difference being the brown, tomentose under surface of leaves of P. villosa.

235. Rhododendron arboreum, *Sm.*—*Syn.* R. puniceum, *Roxb.;* R. purpureum, *Ham.;* R. album, *Ham.* and *Wall.* (with

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approximate filaments); R. cinereum, *Wall.*; R. Rollinsonii, *Gard.*; R. nilagiricum, *Zenk.*; R. Campbelliæ, *Hook. fil.*

Order XXXVI.—MYRSINACEÆ.

236. Mæsa montana, *A. DC.*—*Syn.* M. acuminata, *Don*; M. viridiflora, *Hb. Ham.* in Hb. Kew.; M. sinensis and M. indica, *A. DC.*, probably, the venation, toothing, and pubescence of leaves variable; M. dioica and M. nemoralis, *A. DC.*; Bæobotrys nemoralis, *Roxb.*; B. indica, *Wall.*; B. Chishia, *B.* in Hb. Ham. *fide* Hb. Kew.

237 argentea, *Wall.*—*Syn.* Bæobotrys lanceolata, *Wall.*

238. Embelia villosa, *Wall.*—*Syn.* E. reticulata, *Wall.* Is near E. robusta, *Roxb.*, differing chiefly in being tomentose under leaves, and having longer, slender, fascicled racemes, *Wall.* *Vern.* Bebrang, Oudh.

239 robusta, *Roxb.*—*Syn.* E. Tsjeriam Cottam and E. picta (?), *A. DC.* It seems rather odd that, though this and E. villosa are near E. Ribes, the source of the true bebarang, and common in parts of Siwalik tract, yet the fruit of neither is used medicinally, while the fruit of two other quite different plants, Myrsine africana and Mallotus philippinensis, are collected and used as bebarang in parts of North India, the latter especially at Almora, where E. robusta is abundant within a few miles.

240 Myrsine africana, *L.*—*Syn.* M. bifaria, *Wall.* The differences appear to be slight and variable. M. Potamac, *Don*; M. retusa, *Ait.*; M. rotundiflora, *Lam.*; M. scabra, *Gært.*

241. semiserrata, *Wall.*—*Syn.* M. Wallichiana and M. acuminata, *Hb. Royle.*

242. Ardisia humilis, *Vahl.*—*Syn.* A. solanacea, A. umbellata, and A. colorata (?), *Roxb.*; A. littoralis, A. grandiflora, A. Domea, A. oleracea, and A. Wightiana, *Wall.*

243. Reptonia buxifolia, *A. DC.*, tab. 34.—*Syn.* Monotheca muscatensis, *A. DC.*; Edgeworthia buxifolia, *Falc.*

Order XXXVII.—SAPOTACEÆ.

244. Bassia latifolia, *Roxb.*

245. butyracea, *Roxb.*, tab. 35.

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ORDER XXXVIII.—EBENACEÆ.

246. Diospyros exsculpta, *Ham.*—*Syn.* Wight Ic. t. 182, 183; Bedd. Fl. Sylv. t. 66.—*Syn.* D. tomentosa, *Roxb.* (not Poiret); D. Tupru, *Ham.* (*Buchanan*).
247. Melanoxylon, *Willd.* in Roxb. Cor. Pl. t. 46.—*Syn.* D. Wightiana and D. dubia, *Wall.*; D. Roylei, *Wall. Cat.* 4134.
248. Lotus, *L.*, tab. 36.—*Syn.* Lotus africana, *Matth.*
249. montana, *Roxb.*—*Syn.* D. cordifolia, *Roxb.*; D. rugulosa, *R. Br.*; D. rugulosa, *A. DC.*; D. Goindu, *Dalz.*; D. Waldemarii, *Klotsch.*; D. orixensis, *Willd.* (possibly).
250. embryopteris, *Pers.*—*Syn.* D. glutinosa, *Kœn.* and *Wall.*; D. citrifolia, *Wall.*; Embryopteris glutinifera, *Willd.*; E. peregrina, *Gœrt.*

ORDER XXXIX.—STYRACACEÆ.

251. Symplocos cratægoides, *Don.*—*Syn.* S. paniculata, *Wall.*; S. Sumuntia, *Don.*; Lhodra cratægoides, *Dcne.*
252. ramosissima, *Wall.*
223. polystachya, *Wall.*; probably the same as S. spicata, *Roxb.*
254. Hamiltoniana, *Wall.*
255. racemosa, *Roxb.*—*Syn.* S. lucida, *Wall.*; S. nervosa, *A. DC.*

ORDER XL.—OLEINEÆ.

256. Fraxinus floribunda, *Wall.*, tab. 37.—*Syn.* F. urophylla, *Wall.*, of Pandua and Khāsya is possibly identical with, or a variety of this. Very near F. ornus, *Pers.*, the flowering ash; "but differs chiefly in having very acuminate, acutely serrate leaflets." Near F. retusa, *Champ.*, Hongkong and Amoy; but its leaflets are much reticulate, its calyx is twice as long and not deeply lobed as in this, and fruit deeply notched, Ornus floribunda, *G. Don.*
257. excelsior, *L.*—*Syn.* F. apetala, *Lam.*; F. ornus, *Scop.*; F. rostrata, *Guss.*; F. erosa, *Pers.*
258. Moorcroftiana, *Wall.*—*Syn.* F. zanthoxyloides, *Wall.*; Ornus Moorcroftiana and zanthoxyloides, *Don.*
259. Syringa Emodi, *Wall.* Is near S. josikæa, *Jacq.*, and resembles S. villosa, *Vahl.*

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260. Syringa persica, *L.*—*Syn.* S. babylonica, *Pluk.*; S. capitata, *Gmel.*; Lilac persica, *Lam.*; L. minor, *Mœnch.*; L. sterilis, *Lavy.*

261. Olea europæa, *Linn.*, tab. 38.—*Syn.* O. cuspidata, *Wall.*; O. ferruginea, *Royle.*

262. glandulifera, *Wall.*—*Syn.* O. paniculata, *Roxb.* and *DC.* (*non* R. Br.); O. Roxburghiana, *Roem.* and *Sch.*; O. acuminata, *Falc.* in Herb.

263. Osmanthus fragrans, *Lour.*—*Syn.* Olea fragrans, *Thbg.*; O. acuminata and O. grata, *Wall.*

264. Ligustrum robustum, *Hook. f.* and *Th.*—*Syn.* L. lucidum, *Hb. Ham.*; Olea robusta and O. grandiflorum, *Wall.*; O. Roxburghii, *Spr.*; Phillyrea robusta, *Roxb.*; P. terminalis, *Hb. Roxb.*; P. grandiflora, *Wall.*; Visiania robusta, *DC.*

265. compactum, *Hook. f.* and *Th.* It seems very doubtful if this is aught but a variety of L. robustum.

266. Nyctanthes arbor-tristis, *L.*—*Syn.* Scabrita triflora and S. scabra, *L.*; Parilium arbor-tristis, *Gært.*, i. t. 51.

267. Schrebera swietenioides, *Roxb.*

Order XLI.—APOCYNACEÆ.

268. Carissa Carandas, *L.*—*Syn.* C. congesta, *Wt.*; Echites spinosa, *Burm.*; Capparis Carandas, *Gmel.* Is supposed by some authorities to be produced by the continued cultivation of C. diffusa.

269. diffusa, *Roxb.*—*Syn.* C. villosa and C. edulis, *Roxb.*; C. hirsuta, *Roth.*; C. ovata, *Wt.*

270. Wrightia tomentosa, *Rœm.* and *Sch.*—*Syn.* W. mollissima, *Wall.*; W. pubescens, *Roth.* (*non* R. Br.); W. Wallichii, *A. DC.*; Nerium tomentosum, *Roxb.* W. pubescens, *R. Br.*, of Malayan Archipelago and Australia, is very near and may prove to be identical with this.

271. Alstonia scholaris, *R. Br.*—*Syn.* A. cuneata, *Wall.*; Echites scholaris, *Roxb.*

272. Holarrhena antidysenterica, *Wall.*, tab. 40.—*Syn.* H. pubescens, *Wall.*; H. codaga, *G. Don*; Echites antidysenterica, *Roxb.*; Chonemorpha antidysenterica, *G. Don.*

Order XLII.—ASCLEPIADEÆ.

273. Calotropis gigantea, *R. Br.*—*Syn.* Asclepias gigantea, *Willd.*

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274. Calotropis procera, *R. Br.*—*Syn.* C. heterophylla, *Wall.;* C. Hamiltonii and C. Wallichii, *Wt.;* Asclepias gigantea, *L.;* A. procera, *Willd.*

ORDER XLIII.—BORAGINEÆ.

275. Cordia Myxa, *L.*—*Syn.* C. latifolia, *Roxb.* (with thicker, broader, and more pubescent leaves); C. monoica, *Roxb.* (*?*); C. polygama, *Roxb.* (more tomentose); C. dichotoma, *Forst.;* C. Brownii, *DC.;* C. Perrottetii, *DC.* (*?*); C. ixiocarpa, *F. Müll.;* C. officinalis and C. africana, *Lam.;* C. domestica, *Roth.;* C. Sebestena, *Forsk.;* C. indica, *Wt.;* C. obliqua, *Willd.*, on good authority and to all appearance is merely a glabrous variety of this.

276. Rothii, *Rœm.* and *Sch.*—*Syn.* C. angustifolia, *Roxb.;* C. subcordata, *Lam.;* C. reticulata, *Roth.;* C. cuneata, *Heyne;* C. oblongifolia, *Hochst.;* C. subopposita, *DC.* (more glabrous than usual); Cornus sanguinea, *Forsk.* (*non* L.) C. quercifolia, *Kl.*, and *C.* crenata, *Del.*, are very near this.

277. M'Leodii, *Hook. f.* and *Th.*, tab. 41.—*Syn.* C. tomentosa, *Wall.*(*?*); Hemigymnia M'Leodii, *Griff.;* C. Wallichii, *G. Don;* known by a similar native name (dahiwan) in Western Ghāts, Bombay; has leaves very like this species, but more rounded, acute, three-nerved, glabrous above, white tomentose below, calyx irregularly lobed, &c. Is in same section with C. Myxa, *L.*

278. vestita, *Hook. f.* and *Th.*—*Syn.* C. incana, *Royle;* Gynaion vestitum, *DC.;* C. fulvosa, *Wt.*, of Concan, &c., is very like this, but young leaves are very pilose, as those of C. M'Leodii, and flowers generally in lateral close cymes.

279. Ehretia serrata, *Roxb.*—*Syn.* E. pyrifolia, *Don.;* E. ovalifolia, *Wall.* (*non* Wt.); E. acuminata, *R. Br.*, of Australia, is possibly identical, *fide* Bentham in Flora Austral.

280. lævis, *Roxb.*, tab. 42, Cor. Pl. t. 56; *Wight Ic.* t. 1382. —*Syn.* E. punctata, *Roth.;* Beurreria lævis, *G. Don. Vern.* Chamror, Gīn, Panjab; Kodā, darar, N.W.P.; Chamraud, datranga, Oudh; Tamboli, Bandelkhand; Tambolia, Rajput; Dotti mara, mosonia, bapanabūri, adda bakudū, C. Prov.

281. aspera, *Roxb.*, Cor. Pl. t. 55.—*Syn.* E. ovalifolia, *Wight Ic.* t. 1383 (not Wall.); E. obtusifolia, *Hochst.;* E.

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obovata, *Br.;* E. internodis, *L'Her.;* E. petiolaris, *Lam.;* E. tomentosa, *Roth.;* E. Heynii, *Roem.* et *Schult.;* E. pubescens, *Royle;* E. floribunda, *Royle* (probably); Beurreria aspera, *G. Don. Vern.* Kharawūne, maraghūne, Afg.; badikander, dātnū, chambal, chamror, sakkar, ganger, kālakāt, Pb.

Order XLIV.—BIGNONIACEÆ.

282. Bignonia xylocarpa, *Roxb.*, tab. 43.—*Syn.* Tecoma xylocarpa, *Don.*

283. Calosanthes indica, *Bl.*—*Syn.* Bignonia indica, *Willd.;* B. pentandria, *Lour.;* Spathodea indica, *Pers.*

284. Spathodea falcata, *Wall.*—*Syn.* S. Rheedii, *Spr.* (excl. syn.), *non* Wall. Cat. 6516; S. longiflora, *Pers.;* S. longifolia, *Vent.* ex. *Lam.;* Bignonia spathacea, *L. f.* and *Roxb.;* B. falcata, *Kœn.* (*non* Vell.); B. parviflora, *Hb. Madr.*

285. Stereospermum suaveolens, *DC.*—*Syn.* Bignonia suaveolens, *Roxb.;* B. noctiflora, *Ham.;* B. chelonoides, *Hb. Wt.*, *fide* Wall. Cat.; B. gratissima, *Kœn.;* Tecoma suaveolens, *Don.*

286. chelonoides, *DC.*—*Syn.* Bignonia chelonoides, *L.* Said to be B. quadrilateralis, *Roxb.*, but not so; it is Spathodea Roxburghii, *Spr.*, now Heterophragma Roxburghii, *DC.*

287. Tecoma undulata, *G. Don.*—*Syn.* T. glauca, *DC.;* Bignonia undulata, *Roxb.;* B. salicifolia, *Hb. Ham.;* B. glauca, *Decaisne* (*non* Wall).

Order XLV.—VERBENACEÆ.

288. Tectona grandis, *L. fil.*, tab. 44.

289. Premna serratifolia, *L.*—*Syn.* P. integrifolia, *L.;* P. corymbosa, *Rottl.* and *Willd.;* P. spinosa, *Roxb.*, *fide* Hb. Wall.; Folium hirci, *Rumph.;* Cornutia corymbosa, *Burm. fide* Roxb.; Gumira littorea, *Rumph.;* G. integrifolia, *Hassk.*

290. interrupta, *Wall.*—*Syn.* P. ovalifolia, and P. divaricata, *Wall.;* P. scandens, *Bojer.*

291. latifolia, *Roxb.*—*Syn.* Vitex pedda-nella, *Roxb. MSS.* Thwaites suggests that it should be joined with P. serratifolia, *L.*, also with P. viburnoides, *Wall.;* but although in some points it resembles each of these, it differs sufficiently to keep it specifically distinct.

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292. Premna mucronata, *Roxb.*—*Syn.* P. glaberrima, *Wt.*; P. micrantha, *Schauer.*

293. barbata, *Wall.*—*Syn.* P. serratifolia, *Roxb.* (*non* L.) in Hb. Ham. *fide* Wall. Cat. 1768; P. hircina, *Buch.*; Callicarpa barbata, *Wall.* in Hb. Kew.

294. Gmelina arborea, *Roxb.*—*Syn.* Premna arborea, *Roth.*

ORDER XLVI.—SALVADORACEÆ.

295. Salvadora persica, *L.*—*Syn.* S. persica, *Roxb.*; S. indica, *Wt.*; S. Wightiana, *Pl. MSS.* in Hb. Kew; S. pubescens, *Pl.*; S. madurensis, *Decsne.*, apparently; S. crassinerva, *Hochst.* in Hb. Kew; S. paniculata, *Zucc.* in Hb. Kew; S. Stocksii, *Wt.* (merely a badly marked variety with some points, such as short pedicels, resembling S. oleoides, *Decsne.*); Cissus arborea, *Forsk.*

296. oleoides, *Decsne.*, tab. 39.—*Syn.* S. indica, *Royle, Ill.* p. 319; S. persica, *L.*, *Wt. Ic.*, note on t. 1621; and T. Anderson, Jour. Lin. Soc., vol. v. suppl. i. p. 29; S. paniculata, *Zucc.*, *teste* Anderson (*see* S. persica, *L.*)

ORDER XLVII.—POLYGONACEÆ.

297. Calligonum polygonoides, *L.*—*Syn.* C. comosum, *L'Her.*

ORDER XLVIII.—LAURINEÆ.

298. Cinnamomum Tamala, *Nees.*—*Syn.* C. albiflorum, *Nees;* C. Cassia, *Don;* Laurus Cassia and L. albiflora, *Wall.*

299. glanduliferum, *Meisn.*—*Syn.* Camphora glandulifera, *Nees;* C. caniflora, *Meisn.* (with some difference in size of leaves and more tomentose inflorescence, &c.); Laurus glandulifera, *Wall.* β.

300. Phœbe lanceolata, *Nees.*—*Syn.* Laurus lanceolaria, *Roxb.*; L. lanceolata, *Wall.*; L. pubescens, *Wall.* (in part); Ocotea lanceolata, *Nees* in Wall. Pl. As. Rar.

301. pallida, *Nees;* is very like and may prove to be identical with P. lanceolata, but has more rigid leaves, with ribs impressed above, and reticulate venation prominent, conspicuous under; and especially in the inflorescence, which is subcanescent pulverulous, afterwards more or less glabrescent, with long pedicellate flowers, blooming in June. It is a "small tree," which occurs at 4000 to 5000 feet at Kumaon, in moist ravines in outer hills, in Oudh, Nepal, and Tavoy.

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302. Machilus odoratissima, *Nees.*—*Syn.* M. madang, *Miq.;* Laurus indica, *Lour.;* L. odorata, *Wall.;* Phœbe sericea, *Nees.*

303. Beilschmiedia Roxburghiana, *Nees.*—*Syn.* Laurus bilocularis, *Roxb.*

304. Tetranthera laurifolia, *Jacq.*—*Syn.* T. apetala, *Roxb.;* T. sebifera, *Spreng.;* T. Roxburghii, *Nees;* Laurus involucrata, *Retz.;* Litsæa apetala, *Pers.;* L. sebifera, *Juss.;* Sebifera glutinosa, *Lour.;* Tomex sebifera, *Willd.*

305. monopetala, *Roxb.*, tab. 45.—*Syn.* T. macrophylla, *Wall.;* T. alnoides, *Miq.;* Litsæa monopetala, *Pers.;* L. polyantha, *Juss.;* Tomex japonica, *Thbg.* (*fide* Roxb).

306. Litsæa lanuginosa, *Nees.*—*Syn.* Tetranthera lanuginosa, *Wall.;* Tetradenia lanuginosa, *Nees.*

307. consimilis, *Nees.*—*Syn.* Laurus involucrata, *Roxb.;* Tetranthera pallens, *Don;* T. pentandra, *Roxb.;* Tetradenia consimilis, *Nees*, and probably Laurus zeylanica, *Nees*, and L. pulchella, *Meisn.*

308. Daphnidium pulcherrimum, *Nees.*

309. bifarium, *Nees.*—*Syn.* Tetranthera bifaria, *Wall.;* Laurus Nacusua, *Don;* L. nacushia, *Ham. MSS.* Distinguished from D. pulcherrimum by pinnate-nerved leaves, hardly glaucous, and with yellow tomentum under, and 8-leaved involucre.

Order XLIX.—THYMELEÆ.

310. Daphne oleoides, *Schreb.*—*Syn.* D. cachemiriana, *Meisn.* in DC.; D. acuminata, *Stocks;* D. mucronata, *Royle;* D. coriacea, *Hb. Royle;* D. sericea, and D. buxifolia, *Vahl;* D. acuminata, *Bois.;* D. buxifolia, *Huet de Pav.;* D. jasminea, *Sibth.* and *Smith;* D. gnidioides, *Fisch.;* D. collina, *Sebast.* (*?*); D. glandulosa, *Bertol.;* D. lucida, *Lois.;* D. cretica, *Steud.* The materials in Hb. Kew, and the available evidence, seem to prove that all of these are identical, with variations.

311. papyracea, *Wall.*—*Syn.* D. odora, *Don* (*non* Thunb.); D. Bholua, *Don;* D. papyrifera, *Ham. MSS.;* D. cannabina, *Wall.* Is very near D. sinensis, *Lam.;* and differs from D. odora, *Thunb.*, in that the latter has narrower, longer, more coriaceous leaves, shorter flowers, and smaller fruit.

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ORDER L.—ELÆAGNACEÆ.

312. Hippophae rhamnoides, *L.*—*Syn.* H. conferta and fasciculata, *Wall.*; H. salicifolia, *Don.*; H. tibetana, *Schlecht.*; 7000 to 15,000 feet in Tibet, appears to be only a form of this with smaller leaves, both sides lepidote, more numerous, and occasionally ramous spikes.

313. Elæagnus angustifolia, *L.*—*Syn.* E. spinosa, and E. orientalis, *L.*, the latter with leaves often from ovate base broader, and both sides lepidote, and fruit larger; E. incanus, *Lam.*; E. hortensis, *Bieb.*, var. α; E. argentea, *Mœnch*; E. Soongarica, *Pall*, with leaves narrower and shorter, flowers yellow, smaller, and less odorous, and style the same length as anthers; E. Moorcroftii, *Wall.*

314. latifolia, *L.*, tab. 46.—*Syn.* E. arborea, E. triflora, scandent; and E. conferta, *Roxb.*, scandent, and with shorter pedicles; E. Kologa, *Schlecht*, *fide* Dalz.; E. ferruginea, *Wall.*, *Hb. Wt.*; E. fasciculatus, *Griff. Ic.* t. 539.

314. parvifolia, *Royle.*

ORDER LI.—SANTALACEÆ.

316. Santalum album, *L.*—*Syn. S.* myrtifolium, *Roxb.* and *Wall.* (*?*); Sandalum album, *Rumph.*; Sirium myrtifolium, *L.* The variety, β. myrtifolium, known as a smaller tree, with narrower leaves and paler below, the berry rather smaller, and wood not valuable, cannot be distinguished from the typical species.

ORDER LII.—LORANTHACEÆ.

317. Viscum album, *L.*—*Syn.* V. stellatum, *Griff.*, App. No. 1372; and *Don*, *Hb. Wall.* (*non* Ham. in Don).

318. falcatum, *Wall.*—*Syn.* V. monoicum, *Roxb.*, not distinguishable from this, *fide W.* and *A.*, and the recorded description corroborates this view; but there is not enough material available to settle this point. Is also very near V. orientale, *Willd.*

319. attenuatum, *DC.*—*Syn.* V. dichotomum, *Don* (54 *DC.*); V. elongatum, *Wall.* (55 *DC.*); V. compressum, *Lam.* and *Poir.* (under 58 *DC.*); V. opuntioides, *L.* in Hb. Heyne.

320. articulatum, *Burm.*—*Syn.* V. japonica, *Thbg.*; V. opuntia, *Thbg.* in Flor. Japonica; V. moniliforme, *Bl.*; V. coralloides, *Wt.*, is not apparently different, and is common on hills in Madras Presidency.

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321. Arceuthobium oxycedri, *Bieb.*—*Syn.* V. oxycedri, *DC.*; Razoumowskia caucasica, *Hoffm.*, in Hort. Mosq.
322. Loranthus ligustrinus, *Wall.*
323. pulverulentus, *DC.*
324. cordifolius, *Wall.*
325. vestitus, *Wall.*—L. ferruginosus, *Roxb.*, is near this, but has sub-remote, broader, obtuse, flat leaves.
326. umbellifer, *Schult.*—*Syn.* L. umbellatus, *Wall.* (*non* Roth.).
327. longiflorus, *Desr.*—*Syn.* L. bicolor, *Roxb.*; L. falcatus *L.*; L. Wightiana, *Wall*; L. Kœnigianus, *Agardh* (?); Lonicera zeylanica, *Gært.*

ORDER LIII.—EUPHORBIACEÆ.

328. Phyllanthus nepalensis, *Mull.*—*Syn.* Glochidion velutinum, and perhaps G. arboreum, *Wt.* Probably G. hirsuta, *Roxb.*; G. tomentosum, *Dalz.*; Bradleia ovata, *Wall. Cat.* 7852.
329. bicolor, *Mull.*—*Syn.* Glochidion acuminatum, *Wall.*; G. lanceolarium, *Dalz.*; Briedelia lanceæfolia, *Roxb.*; B. acuminata, *Wall. Cat.* 7885 (*non* P. acuminatus, *Vahl*).
330. Emblica, *L.*, tab. 52.—*Syn.* P. glomeratus, *Wall.*; Emblica officinalis, *Gært.*; Dichelactina nudicaulis, *Hance.*
331. Putranjiva Roxburghii, *Wall.*, tab. 53.—*Syn.* Nageia putranjiva, *Roxb.*
332. Securinega obovata, *Mull.*—*Syn.* Phyllanthus obtusus, *Schrenk* and *Wall.*; P. virosus, *Roxb.* and *Baill.*; P. virens, P. rotundatus, P. griseus, and P. glauca, *Wall.*; P. glauca, *Bl.*; P. retusus, *Roxb.* and *Wall.*; Fluggea leucophylla, *Hb. Heyne*; F. virosa, *Wall.*; F. leucopyrus, *Dalz.* (*non* aliorum), and probably F. microcarpa, *Bl.*; Leptomena melanthesoides, *F. Muell.*
333. leucopyrus, *Mull.*, tab. 54.—*Syn.* Phyllanthus leucopyrus, *Wall.*, *Cat.* 7938, A; Fluggea leucopyrus, *Willd.* in *Roxb.*; F. virosa, *Dalz.*; F. Wallichiana, *Baill.*
334. Bischofia javanica, *Bl.*—*Syn.* B. oblongifolia, B. Cumingiana, B. Roeperiana, and B. Toui, *Dene.* in Jacq.; B. trifoliata, *Hook Ic.*; Andrachne trifoliata, *Roxb.*; A. apetala, *Wall.*; Phyllanthus (?) gymnanthus, *Baill.*; Stylodiscus trifoliatus, *Benn.*; Microelus Roeperianus, *W.* and *A.*
335. Briedelia retusa, *Spr.*, tab. 55.—*Syn.* B. spinosa and B. crenulata, *Roxb.*; B. montana, *Wall.* (*non* Willd. and Roxb.);

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B. amœna, *Baill.*; Cluytia retusa, *L.*; C. spinosa, *Roxb.*; C. squamosa, *Lam.*; Andrachne Doonkyboisca, *Wall.*

336. Briedelia stipularis, *Bl.*—*Syn.* B, scandens, *Willd.* and *Wall.*; B. retusa, *Juss.* (*non* Spr.); B. Zollingeri, *Miq.*, in Hb. Kew; B. tomentosa, *Hort. Bogot.*; Cluytia stipularis, *L.*; C. scandens, *Roxb.*; Zizyphus racemosus, *Wall.*

337. montana, *Willd.*—*Syn.* Cluytia montana, *Roxb.*

338. Cleistanthus oblongifolius, *Mull.*—*Syn.* Cluytia oblongifolia, *Roxb.*; Briedelia oblongifolia, *Hb. Ham.*, *Hook.* and *Arn.* (*?*) The varieties α. scabrous, and β. glabrous, smooth, are not definite, there being gradual variations.

339. Lebidieropsis orbicularis, *Mull.* Muller, in DC. Prod., divides this into three varieties,—α. collina, β. genuina, and γ. Lamberti, which differ only in shape, size, pubescence, &c. of leaves; but the material available renders it probable that these graduate into each other. *Syn.* Cluytia collina, *Willd.* and *Roxb.*; C. patula and C. retusa, *Hb. Wt.*; Bridelia collina, *Wall.* and *Hook.* and *Arn.*; Amanoa collina, *Griff.* in Hb. Kew, and *Baill.*; Andrachne orbicularis, *Roth.*; A. orbiculata, *Rottl.*; A. Cadishaco, *Wall.*; Emblica Palasis, *Hb. Ham.*

340. Croton oblongifolius, *Roxb.* (*non* Dil. *acc.* Sieber).—*Syn.* C. Joufra, *Roxb.* in Hb. Kew; C. Boragatch, C. lævigatum, and C. elæocarpifolius, *Wall.*

341. Trewia nudiflora, *L.*—*Syn.* T. macrophylla, *Roth.*; T. macrostachya, *Klotsch.*; Rottlera indica, *Willd.*; R. Hoperiana, *Bl.*; Tetragastris ossea, *Gært.* ii. t. 109, f. 5.

342. Mallotus philippinensis, *Mull.* Muller notes a variety, "microphylla," with small leaves, which is found in the Philippines; and a second, "flaccida," with flaccid leaves, in the Nilgiris.—*Syn.* Rottlera tinctoria, *Roxb.*; R. coccineas, *Vah.*; R. montana, *Hb. Heyne*, and *Wall. Cat.* 7833, A.; R. mollis, *Wall. Cat.* 7839; R. affinis, *Hassk.*; R. philippensis, *Juss.*; R. aurantiaca, *Hook* and *Arn.*; Croton philippense, *Lam.*; C. punctatus, *Retz.*; C. montana, *Willd.*

343. Homonoya riparia, *Lour.*—*Syn.* Adelia neriifolia, *Roth.* and *Roxb.*; Croton salicifolius, *Geisel.*; Ricinus (*?*) salicinus, *Hassk.*; Spathiostemon salicinus, *Hassk.*; S. javense, *Bl. teste* Thw.; Hæmatospermum salicinum, *Baill.*; H. neriifolium and H. riparium, *Wall.*

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344. Excæcaria insignis, *Mull.*—*Syn.* Falconeria insignis and F. Wallichiana, *Royle;* F. malabarica, *Wt.* These three species were founded on the varying number of ovary cells. Gymnobotrys lucida, *Griff.* Ic. 548, f. 1.

345. acerifolia, *F. Didrichs.*—*Syn.* E. himalayensis, *Mull;* Stillingia himalayensis, *Klotsch.* Is very near E. indica, *Mull.* (Sapium, *Willd.* and *Roxb.*); a small tree of the Ganges Delta, and Port Natal, S.E. Africa, with a "very poisonous juice," a most nauseous-tasted fruit, and seeds used to intoxicate fish by the natives.

346. Buxus sempervirens, *L.*—*Var.* α. grandifolia, with larger and subnarrowed leaves, comes near Wallichiana and longifolia; β. rotundifolia, *Baill.* (*exc. Syn. Lin.*), leaves rotundate or shortly ovate, both ends rounded, or base subattenuated; arboreous; very probably cultivated in gardens; γ. arborescens, *L. sp.*, arboreous or fruticose, branchlets puberulous; in middle and south Europe; δ. angustifolia.—*Syn.* B. chinensis, *Link.;* B. arborea and B. emarginata, *Wall.;* B. longifolia, *Jacqt. Voy. ex* Baill.; B. Wallichiana, *Baill.*

ORDER LIV.—CELTIDEÆ.

347. Celtis australis, *L.*, tab. 50.—*Syn.* C. occidentalis, *L.;* C. caucasica, *Willd.;* C. Tournefortii, *Lam.;* C. tetrandra, *Roxb.;* C. virgata, *Hb. Royle,* C. hyphasios, *Jacqt. MSS.;* C. serotina, *Pl.* From the variations and connecting links the only resource seems to be to unite all these so-called species, thus mostly following the opinion of Hook. fil.

348. Acata, *Ham.;* C. tetrandra, *Roxb.;* C. eriocarpa, *Dcne.* in Jacqt.; C. nepalensis, *Planch.;* C. aggregata, and C. Inglisii, *Hb. Royle.* In most respects is very near, if it is not identical with C. australis, differing most in being more pilose, but in this it is also very variable.

349. trinervia, *Roxb.* (*non* Lam.)—*Syn.* C. Roxburghii, *Pl.*

350. Sponia politoria, *Planch.*—*Syn.* Celtis politoria, *Wall.*

351. orientalis, *Don.*—*Syn.* S. Wightii, Griffithii, and velutina, *Pl.*, do not appear to differ specifically from this; Celtis orientalis, *L.;* Papyrus spuria, *Kœmpf.*

ORDER LV.—ULMACEÆ.

352. Ulmus campestris, *L.*, tab. 51.—*Syn.* α. glabrata, U. virgata, *Roxb.;* β. puberula, U. suberosa, *Ehr.;* U. corylifolia, *Host.;* U. macrophylla, *Spach;* U. erosa, *Roth.* and

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Wall.; U. effusa, *Wall.*; U. Wallichiana, *Pl.* The leaves are polymorphous and vary much in size, and there seems to be no fixed limit between these so-called species.

Of this tree a variety, "pumila" (U. pumila, *Willd.*), should be noted here. It has very much smaller leaves than the normal tree, often half-cordate, less often acuminate, with herbaceous stipules, and the whole is more glabrous; flowers and fruit have not been obtained, so no other difference is as yet known.

353. Ulmus pedunculata, *Foug.*
354. virgata, *Wall.* (*non* Roxb.)
355. Holoptelea integrifolia, *Pl.*—*Syn.* Ulmus integrifolia, *Roxb.*

Order LVI.—ARTOCARPEÆ.

356. Artocarpus integrifolia, *L.*—*Syn.* Sitodium cauliflorum, *Gært.*
357. Lakoocha, *Roxb.*
358. Urostigma religiosum, *Gasp.*—*Syn.* U. affine, *Miq.*; Ficus religiosa, *L.*, *Willd.* in Roxb.
359. cordifolium, *Gasp.*, tab. 48.—*Syn.* Ficus cordifolia, *L.*; Arbor conciliorum, *Rumph.* U. courtallense, *Miq.*, is very like this, chiefly differs in having smaller fruit.
360. infectorium, *Miq.* — *Syn.* Ficus infectoria, *Roxb.*; F. tsjakela, *Burm. Hb. Roxb.*; U. Wightianum, *Miq.* (Ficus Wightiana, *Wall.*), may be identical, as it has similar leaves, but fruit always closely sessile.
361. pseudo-Benjamineum, *Miq.*—*Syn.* Ficus comosa, *Roxb.* (very probably); F. Benjaminea, *Hb. Russ.*; *Wall. Cat.*; *Hb. Wt.* (*non* Willd. *nec* Roxb.); F. parasitica, *Hb. Wt.* Resembles U. pseudo-Tjiela, *Miq.*, but has much longer leaves. "Differs much from U. Benjamineum, *Miq.* (F. Benjaminea, *L.*), in various respects, but is marked at once by the length (1 to 1½ inch) of petiole."
362. bengalense, *Gasp.*—*Syn.* Ficus indica, *Roxb.*; F. bengalensis, *L.*
363. Covellia oppositifolia, *Gasp.*—*Syn.* C. hispida, *Miq.*; Ficus hispida, *L.*; F. oppositifolia, *Willd.* and *Roxb.*
364. macrophylla, *Miq.*—*Syn.* Ficus macrophylla, *Roxb.* (*non* alior.); F. Roxburghii, *Wall.*, and probably F. sclerocarpa, *Griff.* Ic. t. 558.
365. glomerata, *Miq.*, tab. 49.—*Syn.* Ficus glomerata, *Willd.* and *Roxb.*

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366. Ficus Carica, *L.*

367. caricoides, *Roxb.*—*Syn.* Ficus virgata, *Roxb.* "The shape of the leaf constitutes the chief, or at least the most obvious, difference of this from F. Carica" (*Roxb.*); and it is also "near F. pseudo-sycomorus, *Dene.*" (*Miq.*)

368. Morus serrata, *Roxb.*—*Syn.* M. cuspidata, *Wall. Cat.*; M. tartarica, *Wall.*; M. pabularia, *Dene.*

369. alba, *L.*, tab. 47.—*Syn.* M. atropurpurea, *Roxb.*, and *Wt. Ic.*; M. rubra, *Lour. fide* Roxb.; var. α, indica.—M. indica, and M. tartarica, *Willd.*; M. parvifolia, *Royle*; M. dulcis, *Hb. Royle.*

370. lævigata, *Wall.*—*Syn.* M. glabrata, *Wall.*; M. cachemirica, *Hb. Royle.*

371. nigra, *L.*

372. Streblus asper, *Lour.*; Trophis aspera, *Retz.*, and *Willd. MSS.*, *fide* Roxb.; Epicarpurus orientalis, *Bl.*; Achymus pallens, *Sol.*

373. Cudranus amboinensis, *Rumph.*—*Syn.* Cudrania javanensis, *Trec.*; Trophis spinosa, *Willd.*, and *Roxb.*, *fide* Steud.; Batis spinosa, *Roxb.*

374. Plecospermum spinosum, *Trec.*—*Syn.* P. cuneifolium, *Thw.*; Trophis spinosa, *Heyne* in Roxb.; Sphærogalus Roxburghii, *Pl. MSS.* in Hb. Kew.; Batis spinosa, *Roxb.*, *fide* Thw.; but see No. 373.

Order LVII.—CUPULIFERÆ.

375. Quercus semecarpifolia, *Sm.*, tab. 64.—*Syn.* Q. obtusifolia, *Don*; Q. cassura, *Don*, *fide* Loudon.

376. Ilex, *L.*—*Syn.* Q. Ballota, *Desf.*; Q. Baloot, *Griff.* in DC.; Q. affghanistana, *Kotschy.*; Q. Griffithii, *Kotschy.* (*non* Hook. f. and Th.); Q. rotundifolia, *Lam.*, *fide* Kotschy.; Q. ilicifolius, *Griff.*; Q. Baloot, *A. DC.*, appears to be merely a variation of this variable tree, with no difference of specific moment.

377. dilatata, *Lindl.*—*Syn.* Q. floribunda, *Lindl.*

378. lanuginosa, *Don.*—*Syn.* Q. Bangha, *Ham.*; Q. oblongata, *Don*; Q. lanata, *Sm.*, not in DC.

379. incana, *Roxb.*—*Syn.* Q. nepalensis, *Desf.*; Q. lanata, *Loud.*; Q. lanata, *Sm.* in DC. erroneously; Q. dealbata. *Lind.*, *Wall.* (*non* Hook. f. and Th.); Q. castanoides. *Jacqt.*, probably.

380. annulata, *Sm.*, tab. 65.—*Syn.* Q. phullata, *Don*, *fide* Steud., Lindl., Loud.; Q. laxiflora, *Lindl.* in Wall.,

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fide Hb. Lindl.; Q. dentosa, *Lindl.;* Q. Kamroopii, *Don* (269 DC. no doubt the same species); Q. mutabilis, *Edge.*? Q. semiserrata, *Roxb.*

381. Castanopsis tribuloides, *A. DC.*—*Syn.* C. armata, *Miq.;* Castanea armata, *Spach.;* C. sphærocarpa, *Wall.*, Pl. As. Rar.; Quercus armata and Q. ferox, *Roxb.;* Q. tribuloides, *Sm.* in Nees; Q. fenestrata, *Roxb.* in Hb. Wall.

382. indica, *DC.*—*Syn.* Castanea indica, *Roxb.;* Quercus dubia, *Lindl.*

Order LVIII.—CORYLACEÆ.

383. Carpinus viminea, *Wall.*

384. faginea, *Lindl.* in Wall., tab. 66.—"Near C. orientalis, *L.* (C. duinensis, *Scop.*), to which Hartig has referred it, 'an vidit specimen' (*A. DC.*); but form and margin of leaves different, and bracts very different" (*Wall*). Much resembles C. japonica, *Bl.*, as to leaves, but bracts of latter much larger.

385. Corylus Colurna, *L.*—*Syn.* C. bizantina, *Clus.;* C. lacera, *Wall.;* C. Jacquemontii, *Decne.;* C. pontica, *Koch;* C. arborescens, aliquorum hortulorum; Avellana byzantina, *Bauh.* "Very near C. Avellana, *L.*, but always, as in Turkey, forms a tree, with bark more like birch than hazel" (*Hook. f.*)

386. ferox, *Wall.*

Order LIX.—JUGLANDACEÆ.

387. Juglans regia, *L.*—*Syn.* J. villosa, *Wall.*

388. Engelhardtia Colebrookiana, *Lindl.*—*Non* Juglans pterococca, *Colebr. ic. pict.*, as stated in DC.; that is E. spicata, *Bl.* of Roxb. as in DC.

Order LX.—MYRICACEÆ.

389. Myrica sapida, *Wall.*—*Syn.* M. esculenta, *Ham.;* M. octandra, *Don;* M. Farquhariana, *Wall.;* M. integrifolia, *Roxb.*, of Silhet and Khāsia, differs in its greater pubescence, more compact catkins, and larger bracts and fruit.

Order LXI.—PLATANACEÆ.

390. Platanus orientalis, *L.*—*Syn.* P. vulgaris, *Spach.;* α. and β. P. palmata, *Mœnch;* P. hispanica, *Ten.*

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ORDER LXII.—BETULACEÆ.

391. Betula Bhojpattra, *Wall.*—*Syn.* B. utilis, *Don*, *vix* Hook.; B. resinifera, *Royle*, *Ill.* and *Herb.*, "in Kunawur only;" B. Jacquemontii, *Spach.*; B. corylifolia, *Griff.*; *var.* β, tibetica—with lobes of bracts erect, "a different species"? (*J. D. H.*)

392. cylindrostachys, *Wall.*, tab. 56.—*Syn.* B. alnoides and B. nitida, *Don*; B. acuminata, *Wall.*; B. affinis, *End.*; Betulaster cylindrostachys and acuminata, *Spach.*

393. Alnus nepalensis, *Don.*—*Syn.* A. glutinosa, *Willd.* in Roxb.; A. obtusifolia, *Royle*; Betula leptostachya—not "leptophylla" as Regel puts it—*Wall.*; Clethropsis nepalensis, *Spach.*

394. nitida, *Endl.* tab. 57.—*Syn.* A. elongata, *Royle*, *Ill.* and *Hb.*; Clethropsis nitida, *Spach.*

ORDER LXIII.—SALICINEÆ.

395. Salix tetrasperma, *Roxb.*, tab. 58.—*Syn.* S. cuspidata and disperma, *Don*; S. pyrina, *Wall.*; S. glabrata and ichnostachya, *Lindl.*; S. nilagirica and Horsfieldiana, *Miq.*; S. suaveolens and pondicheriana, *Andssn.*; S. myurus and Hugelii, *Wimm.*

396. Safsaf, *Forsk.*—*Syn.* S. subserrata, *Willd.*; S. octandra, *Sieb.*; S. Blanchardtiana, *Schimp.*; S. cyathipoda and axillaris, *Andssn.*

397. babylonica, L., tab. 59.—*Syn.* S. propendens, *Ser.*; S. japonica, *Thbg.*; S. annularis, *Forb.*—a cultivated form with leaves abnormally circinate, reflex, or corrugated.

398. Caprea, *L.*, tab. 60.—*Syn.* S. tomentosa, *Ser.*; S. hybrida, *Vill.*; S. aurigerana, *Lap.*; S. ulmifolia, *Thuill.*; S. Medemii, *Boiss.* (*?*)—Is very near S. aurita and S. cinerea, *L.*

399. Wallichiana, *Andssn.*, tab. 61.

400. daphnoides, *Vill.*, tab. 62.—*Syn.* S. acutifolia, pomeranica, and cinerea, *Willd.*, *Sm.*, and *Link.*; S. pruinosa, *Wendl.*; S. caspica, *Hort.*; S. bigemina and præcox, *Hoffm.*

401. insignis, *Andssn.*—Anderssen states that this is very near S. daphnoides in habit, and the differences he indicates in structure are not very marked.

402. viminalis, *L.*—*Syn.* S. longifolia, *Lam.*; S. virescens, *Vill.*; S. splendens, *Turcz.*

403. pychnostachya, *Andssn.*

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404. Populus alba, *L.*—*Syn.* P. belgica, *Hort. Hoff.*; P. Bachofenii, *Hartig*; P. croatica, *Waldst.* and *Kit.*

405. euphratica, *Oliv.*, tab. 63.—*Syn.* P. lævigata, *Willd.*; P. diversifolia, *Schrenk.*; Balsamifera deltoides, *Griff.*, *Ic.* and *Not.* P. pruinosa, *Schr.*, is very like this species, the chief difference being, that in it all the leaves seem to be entire and pruinose tomentose.

406. nigra, *L.*—*Syn.* P. pannonica, *Kit.*; P. dilatata, *Ait.*; P. fastigiata, *Desf.*; P. nigra-italica, *Du Roi*; P. pannonica-italica, *Mœnch*; P. italica-dilatata, *Willd.*; P. pyramidata, *Hort.*; P. betulæfolia, *Pursh.*; P. Hudsoniana, *Michx. f.*; P. amygdalifolius, *Griff.*

407. P. ciliata, *Wall.*—*Syn.* P. pyriformis, *Royle, Ill.* p. 344—*teste* Hook. in DC. Prod.

408. balsamifera, *L.*—*Syn.* P. Tacamapaca, *Mill.*; P. macrocarpa, *Schr.*; P. laurifolia, *Ledeb.*; P. viminalis, *Lodd.*; P. Lindleyana, *Booth*; P. balsamiflua, *Griff.*; P. viminea, *Bon Jard.*; P. salicifolia and longifolia, *Hort.*

Order LXIV.—GNETACEÆ.

409. Ephedra vulgaris, *Rich.*—*Syn.* E. maritima minor, *Tourn.*; E. distachya, *L.*; E. polygonoides, *Pall.*; E. arborea, *Lagasc.*, *Bert.*; E. minor, *Host.*; E. helvetica, *C. A. M.*; E. intermedia, *Schrenk.* and *C. A. M.*; E. Gerardiana, *Wall.*

410. alte, *C. A. M*, tab. 69.—*Syn.* E. foliata, *Boiss.*; E. alata, *Schimp.* (*non* Dcne.); E. ciliata, *Fisch.* and *Mey.*

Order LXV.—CONIFERÆ.

411. Pinus longifolia, *Roxb.*; Griff. Ic. t. 369 and 370.

412. Gerardiana, *Wall.*, tab. 67.—*Syn.* P. Neosa, *Govan MSS.*

413. excelsa, *Wall.*—*Syn.* P. pendula, *Griff.*; P. Chylla, *Lodd.*; P. Cembra *var.* fruticosa, and P. Peuce, *Griseb.*

414. Deodara, *Roxb.*—*Syn.* P. cedrus, *L.*; P. atlantica, *End.*; Cedrus Deodara, *Loud.*; C. indica, *De Chamb.*; C. libani, *Barr.*; C. atlantica, *Man.*; C. africana, *Gord.*; C. argentea, *Hort.*; Abies Deodar, *Lindl.*; A. atlantica, *Lindl.* and *Gord.*; Larix orientalis, *Tourn.*; L. Cedrus, *Mill.*; L. patula, *Salisb.*

415. Smithiana, *Lamb.*—*Syn.* P. khutrow, *Royle*; Picea Morinda, *Link.*; P. khutrow, *Carr.*; Abies Smithiana, *Loud.*; A. spinulosa, *Griff.* Ic. t. 363.

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416. Pinus Pindrow, *Royle.*—*Syn.* P. Webbiana, *Wall.*; P. striata and spectabilis, *Lamb.*; P. tinctoria, *Webb.*; P. naphtha, *Hort.*; Picea Webbiana and Pindrow, *Loud.*; P. Herbertiana, *Madd.*; Abies Webbiana, *Lindl.*; A. Pindrow and spectabilis, *Spach*; A. densa, *Griff.*; Taxus (?) Lambertiana, *Wall. Cat.* 6056.

417. Royleana, *Jameson.*—*Syn.* P. kasya, *Parl.*

418. kasya, *Royle.*—*Syn.* P. nepalensis, *Pin.*, *Wob.*; P. sinensis, *Endl.*; P. khasiana, *Hook. f.* and *Th.*

419. Griffithii, *Parl.*—*Syn.* Larix Griffithii, *Hook. f.* and *Th.*

420. dumosa, *Don.*—*Syn.* P. decidua, *Wall. MSS.*; P. Brunoniana, *Wall.*; Abies Brunoniana, *Lindl.*; A. dumosa, *Loud.*; Tsuga Brunoniana, *Carr.*

421. Cupressus sempervirens, *L.*—*Syn.* C. pyramidalis, *Targ.*; C. fastigiata, *DC.*; C. conoidea, *Spad.*

422. torulosa, *Don*, and *Wall. Cat.* 6046.—*Syn.* C. Tournefortii, *Ten.*; C. sempervirens, *Roxb.*, from the "meridional" hills of Oudh; C. pendula, *Griff.*, *fide* Parlatore in DC. (*sed non*, that being probably C. funebris, *Endl.*); Thuja orientalis, *L.*, *Hb. Webb.*

423. Juniperus communis, *L.*—*Syn.* J. nana, *Willd.*, and other synonyms. Nomenclature as in DC. Prod. xvi. pt. ii. pp. 479, 480.

424. recurva, *Ham.*, var. *β.* squamata.—*Syn.* J. squamata, *Ham.*, p. 55, Prod. Flor. Nepal.; J. densa, *Gord.*; J. Lambertiana and rigida, *Wall. MSS.* A shorter and denser decumbent, very ramous form, the bark not scaling off, with rather broader sometimes subrecurved, acerose leaves, and globular berry.

425. Wallichiana, *Hook. f.* and *Th.*—By Parlatore in DC. Prod. this is amalgamated with J. pseudo-sabina, *Fisch.* and *Mey.*, of Siberia, but at Kew is considered to be a distinct species.

426. excelsa, *Bieb.*, tab. 68.—*Syn.* J. religiosa, *Hort.*

427. Taxus baccata, *L.*—*Syn.* T. nucifera, *Wall.*; T. virgata, *Wall.* in Hb. Kew; T. nepalensis, *Jacqt.*; T. Wallichiana, *Zucc.*

Order LXVI.—PALMACEÆ.

428. Calamus Rotang, *L.*—*Syn.* C. scipionum, *Lour.*; C. Roxburghii, *Griff.* Ic. t. 192.

429. Royleanus, *Griff.*—*Syn.* C. Roxburghii, *Royle Ill.* p. 396.

430. Borassus flabelliformis, *L.*—*Syn.* Lontarus domestica, *Rumph.*

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431. Chamærops Martiana, *Mart.*
432. Ritchieana, *Griff.*
433. Phœnix sylvestris, *Roxb.*—*Syn.* P. acaulis, *Buch.*; P. humilis, *Royle;* Elate sylvestris, *L.*, var. β. acaulis.—*Syn.* P. acaulis, *Buch.*, var. γ. melanocarpa.
434. dactylifera, *L.*

ORDER LXVII.—GRAMINEÆ.

435. Arundinaria falcata, *Nees.*—*Syn.* A. interrupta, *Trin.*; A. utilis, *Edge.*; *H. Cleyh.*; Ludolfia falcata, *Nees.*
436. Thamnocalamus Falconeri, *Hook. f.*—*Syn.* Bambusa floribunda, *Munro*, Hb. T. C. Dub.
437. spathiflorus, *Munro.*—*Syn.* Arundinaria spathiflora, *Trin.*; A. procera, *Wall.* (Hb. Mus. Brit.); Bambusa mucro, *Wall.* (Hb. Kew); Genus novum Bambusæ affine, *Wall. Cat.* 5041.
438. Bambusa nutans, *Wall.*—Is very near B. tulda, *Roxb.*, but appears to differ constantly in certain points, especially in the *few* fertile spikes.
439. Falconeri, *Munro.*
440. arundinacea, *Retz* and *Roxb.* (*non* Willd.)—*Syn.* B. spinosa, *Nees* (*non* Roxb.); B. Arundo, *Hb. Klein.*; B. orientalis, *Nees*, in Wt. 206 B); B. Neesiana, *Arn. MSS.*; Arundo Bambos, *L.*; Bambos arundinaria, *Pers.*; Nastus arundinaceus, *Sm.*
441. spinosa, *Roxb.*—*Syn.* B. arundinacea, *Thw.* (*non* Retz); Arundo indica arborea, *Burm.*; A. arbor spinosa, *Rumph.*; A. Bambos, *Hb. Roxb.* (*non* L., see No. 440).
442. vulgaris, *Wendl.*—*Syn.* B. Thouarsii, *Kth.*; B. surinamensis, *Rupr.*; B. Sieberi, *Griseb.*; B. humilis, *Reich. MSS.*; B. auriculata, *Kurz;* Nastus Thouarsii, *Rasp.*; forsan viviparum, *Rasp.*
443. Dendrocalamus strictus, *Nees*, tab. 70.—*Syn.* Bambusa stricta, *Roxb.*; B. verticillata, *Hb. Rottler* (*non* Willd.); B. glomerata, *Hb. Royle.*; B. tanæa, *Hb. Ham.* in Wall. Cat. 5030 A).; B. pubescens, *Lodd.* and *Lindl.*; B. and Arundo hexandra, *Hb. Roxb.*; Nastus strictus, *Sm.*
444. Parishii, *Munro.*

[This List having been printed after Dr Stewart's death, has not had the benefit of his corrections.]

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III. *Note on the further Discovery of a species of* Pothocites (Paterson), *in the Lower Carboniferous Rocks near West Calder.* By R. Etheridge, Jun., F.G.S.

The fossil plant I bring under the notice of the Society this evening was described and figured by Dr Paterson, in the "Botanical Society's Transactions" (vol. i. p. 45), 1844, from the black bituminous shale laid bare on the beach at Wardie (Newhaven), under the name of *Pothocites Grantoni.*

I am not aware that this interesting plant has been obtained since the time of its first discovery until the four specimens now exhibited were found by Mr James Bennie, fossil-collector to the Geological Survey of Scotland, at two localities near West Calder, and form part of the Survey Collection. Dr Paterson described his specimen as being the impression of a distinctly striated stem, terminated by a cylindrical head or catkin. At one portion of the stem he observed an enlargement (*a* on plate) abruptly broken off, probably the remains of a deciduous leaf or spatha. He further described the cylindrical head or spike as divided into three nearly equal portions, without structure, except a distinctly longitudinal striated appearance. The remainder of the head thickly set with round or quadrangular bodies, arranged in four or five rows parallel to each other and the cylindrical head. These bodies were observed to be crowned with from four to five, generally four, ovoid and obtuse projections, with elevated edges, and a central depression, to which the flowering part had been attached.

Dr Paterson considered the generic affinities of the Granton fossil to be near those of *Typha* or *Pothos*, perhaps an extinct species of the latter, or at all events closely allied to it. He proposed for it the name of *Pothocites Grantoni.* The specimen appears to have been examined by Professor Henslow, who considered that the spadix was continuous and not jointed, the jointing being due to compression.

The four specimens exhibited represent two individuals, one of which shows the character of the head, the other that of both head and stem. The chief point of difference between these and Dr Paterson's specimen is, that in one there is no trace of the round or quadrangular bodies

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scattered over the cylindrical head, although the latter is longitudinally divided in the original specimen, but into three divisions, instead of four or five. Further, it may be noticed,—

1*st*, That the cylindrical head is divided into four portions, which decrease in size as the point of attachment with the stem is receded from.

2*d*, That the number of divisions was probably more than four, as the terminal one preserved on the shale shows traces of having had another attached to it.

3*d*, That the longitudinal divisions of the cylindrical head were apparently crossed by transverse ridges, which may perhaps be caused by imperfect preservation, or some peculiar state of the scattered rounded or quadrangular bodies mentioned by Dr Paterson.

4*th*, That these specimens bear out the view taken by Dr Paterson, that the head was subdivided into segments or portions, and that this character is not due to pressure, as supposed by Professor Henslow.

5*th*, That the stem was branched, both main stem and branch being similarly striated.

6*th*, That small enlargements occur along the course of the stems at regular intervals, jutting out one on each side, opposite one another. One of these, noticed by Dr Paterson on his specimen, was considered to be the remains of a deciduous leaf or spatha.

7*th*, That the exposed surface of the segments of the cylindrical head in the Granton specimen appears to be longitudinally divided into four or five ridges, on which were placed the ovoid bodies, whereas in the present specimens there are only three such ridges.

I leave the specific identity of these specimens an open question, until we are better acquainted with this peculiar plant. Should it prove to be specifically distinct from that described by Dr Paterson as *P. Grantoni*, I think we could not do better than call it *P. Patersoni*.

Localities.—1. From black bituminous shale, overlying the oil shale worked at Raeburn's Pit, near Gunn's Green Toll Bar about 1¼ mile north of West Calder. 1. From similar shale at Fell's Pit, near the north-west corner of Briestonhill Moss, about ¾ mile north of West Calder.

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IV. *Notes on* Eucalyptus Globulus. By Mrs Wright, Halston Hall. Communicated by Mr Sadler.

The *Eucalyptus Globulus* was first planted at Cannes, in Mr Woolfield's garden, in May 1863. The seeds had been sown in March 1862; the plants were 12 feet high in September 1863, flowered in 1866, and in 1872 measured 60 feet in height. The tree has been largely introduced into Spain and Algeria. It flourishes all along the Riviera, from Marseilles to Genoa. The fresh leaves were used with good results in cases of hospital gangrene and asthma by Dr C. Battersby, during the Franco-Prussian war, and an essential oil expressed from them has been used for rheumatism. Dr Cleghorn said that the tree had been introduced largely on the Nilghiri Hills, and is now used for many purposes. Mr Etheridge said he had seen a tree in Australia, which, when cut down, measured 375 feet. A red gum exuded from it; the wood is of a blood-red colour, and sinks in water. Throughout the Australian colonies the ethereal oil was believed to be a cure for rheumatism.

V. *Notes on the Open-Air Vegetation at the Royal Botanic Garden.* By James M'Nab, Curator.

On March 12 I gave my second list for the year of the flowering spring plants. The following four species complete the series:—

	1874.	1873.
Narcissus Pseudo-Narcissus, .	March 14	April 1
moschatus, . .	„ 16	„ 20
Adonis vernalis, . .	„ 18	„ 21
Fritillaria imperialis, . .	„ 22	„ 22

The unusual mildness of the winter and spring has brought forward forest vegetation near Edinburgh, to an extent which I do not recollect having before observed. At present (April 9) many forest and ornamental trees are in flower, such as the Norway and other maples; also various species of elm, willow, birch, pyrus, prunus, and the common gean, now white with blossom. A green hue pervades many forest and ornamental trees, as horse chestnuts, lime, larch, whitebeam, laburnums, balsam poplar,

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and thorn. Many common thorns are in full leaf, and one with flowers already expanded. On March 10 last year it was stated that, with the exception of the elm, forest trees showed little sign of flowering. Instead of the usual east winds, so destructive to the blossom of fruit trees, strong west and north-west winds have prevailed. The temperatures during the past month have been milder than during the previous one. The thermometer has only been three times at or below freezing point, viz., March 25, 27, and April 4, indicating, respectively, 28°, 26°, and 32°—the highest morning temperatures being on March 15, 16, 17, 22, 23, and 24, indicating 45°, 45°, 48°, 46°, 48° and 45°. I lay on the table the flowers of 236 species of trees, shrubs, and herbs, picked in bloom on April 6, an unusual number for this season. The number of bulbous plants in flower, tulips, narcissus, and hyacinths, seems to indicate that the soil is in a warmer condition than usual at this time. This may also account for the premature movements of a tortoise, which has been in the garden for upwards of fifty years. It generally buries itself in the soil about the beginning of October, and reappears about the second week of April. This year it came out of its winter retreat on March 15, earlier than it has ever done.

VI. *Notice of Chinese* "Lan-hwa." By Dr JAMES GALT, Hangchow, in a letter to Professor BALFOUR.

Dr Galt says:—"The Rev. G. E. Moule pointed out to me in your 'Manual of Botany,' that the Chinese name of *Olea fragrans*, Lan-hoa—or as frequently written, Lan-hwa—was a mistake for Kwei-hwa."

Professor Balfour exhibited a series of pen-and-ink drawings of the plant, and read a translation by Dr Galt of the Chinese description of it, expressed in very flowery and extravagant language. The plant belongs to the Orchidaceæ, and prefers a moist locality. The Chinese are very fond of it, and it may be seen in almost every house in early spring.

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VII. *Miscellaneous Communications.*

1. A note was read from Dr T. Ogier Ward, Eastbourne, calling attention to a specimen of *Stigmaria* he had collected, in which the radiations surrounding the stigmata pass beyond the edge of the stigmas, and form a minutely reticulated surface, covering the intervals between the stigmata. He had also collected in the Weald, in the neighbourhood of Eastbourne, *Pecopteris Geinitzii*, a fossil fern new to England, and at Stonesfield, last summer, specimens of *Cardiocarpum*.

2. Dr MacLaren, Dehra Doon, India, sent eight photographs, representing *Ficus religiosa*, growing epiphytically on trees of Jamun (*Eugenia Jambolana*, Lam.) and Mango.

14th May 1874.—Sir Walter Elliot, K.C.S.I., Vice-President, in the Chair.

The following Candidates were elected Resident Fellows:—

Archibald Geikie, LL.D., F.R.SS. L. and E., Professor of Geology and Mineralogy in the University of Edinburgh, and Director of the Geological Survey of Scotland,

Rev. James Mitchell, M.A., The Manse, Hermitage Place, Leith.

The following Communications were read:—

I. *On Ville's Researches on the Extraction of Oils from Various Seeds by Hydrocarbons.* By Andrew Taylor, F.R.P.S.

(This paper has since appeared in the "Farmer" newspaper for May 1874.)

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II. *Notes on a Botanico-Geological Trip to Clova, Forfarshire, in April* 1874.

1. *Botanical Notes, by Professor Balfour.*

On April 22, a party of botanists and geologists, consisting of myself, Professor Geikie, Drs Stuart and Aitken, Major Loch, Messrs W. B. Boyd, Ellis, Gibson, Leslie, Ogilvie, Davidson, and Isaac B. Balfour, proceeded by train to Perth, and next morning travelled to Kirriemuir, and thence to Clova, a famous botanical station in the Grampians. We reached Clova about 5 P.M. on the 23d, after many delays. The weather was charming, and continued so for a week.

On April 24, we went up Glen Clova to Acharne, the shooting lodge of the Earl of Southesk, who kindly allowed us to put up our conveyances at the farm-house. From Acharne the party proceeded towards Glen Dole. Here the botanists and geologists separated, the latter proceeding by the Glen Dole road to the top of the mountains, walking along the rocks above Glen Fee, and descending into Glen Clova, after a long and fatiguing journey. The botanists visited the lower part of Glen Fee and the western side of Glen Dole. They examined the rocks in Glen Fee where *Oxytropis campestris* grows, and with the plant took specimens of the rock for the determination of the geologists. They also visited the rocks at the upper part of Glen Dole, where *Astragalus alpinus* grows. These rocks are very rich in plants, and consist of remarkably twisted and contorted gneiss, specimens of which were collected. The vegetation of the glen was advanced, some plants being gathered in flower which rarely blossom so early. Among them may be mentioned *Arctostaphylos Uva-ursi*, *Vaccinium Vitis-Idœa*, *Anemone nemorosa*, *Saxifraga oppositifolia*, forming large pink patches on the rocks; *Luzula campestris*, *Empetrum nigrum*, *Eriophorum vaginatum*, and *Cardamine hirsuta*. Among the other plants noticed in flower in the glen at Clova were *Ulex europœus*, *Sarothamnus scoparius*, *Genista anglica*, *Prunus Avium*, and *Ranunculus Ficaria*. Among the plants not in flower which attracted notice were *Silene*

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acaulis, *Saxifraga hypnoides* and *aizoides*, *Draba incana*, *Pyrola media*, *rotundifolia*, *secunda*, *Oxyria reniformis*, *Gnaphalium supinum*, *Dryas octopetala*. The following ferns were also gathered:—*Lastrea Oreopteris*, *Athyrium Filix-fœmina*, *Polystichum Lonchitis*, *P. aculeatum*, *Polypodium alpestre*, *P. vulgare*, *Asplenium viride*, *A. Trichomanes*, *Botrychium Lunaria*, and *Allosorus crispus*. All the British Lycopods except *inundatum* were gathered. Mr W. B. Boyd collected some good mosses, including *Trichostomum glaucescens*, confined to the rock in Glen Fee on which *Oxytropis campestris* grows. It occurred in considerable abundance and in fruit.

On the 25th, the party again went to Acharne, and thence up Glen Esk to Bachnagairn, and by Loch Esk to the White Water and Little Gilrannoch. Again the day was all that could be desired. The snow near the summits of the hills was refreshing; and on one slope it was so abundant and firm as to allow of a glissade with our poles. This day the botanists and geologists kept together. We examined Little Gilrannoch, a rocky summit, which is interesting as yielding the *Lychnis alpina*, one of our rarest alpine plants, and associated with it dwarf specimens of *Armeria maritima* and *Cochlearia officinalis*, the alpine variety, and *Luzula spicata*. The rocks were specially examined by the geologists.

On Monday (27th), the geological party went to Stonehaven, to examine the Old Red Sandstone, while Dr Aitken, Messrs Gibson, Davidson, and myself remained at Clova. This day we visited Loch Brandy and Loch Wharral, and the rocks around them. We noticed particularly the vast crevasse formed at the top of the Snubb by the separation of a great mass of rock, which is gradually giving way, and will ultimately be precipitated into Loch Brandy. *Saxifraga oppositifolia* was seen as formerly in fine flower. *Azalea procumbens* was also gathered. In Loch Brandy *Isoetes lacustris* and *Lobelia Dortmanna* were met with. In ascending the mountains this day we saw a fine effect produced by the thick white mist resting in the valley, while we were on the mountain above it enjoying clear sunshine.

On Tuesday the party broke up, some going to Killicrankie by Glen Tilt, others returning to Edinburgh.

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2. *Notice of Mosses, collected by William B. Boyd of Ormiston.*

The following mosses were observed in Glen Fee and Glen Dole:—

Grimmia Doniana in large tufts, and in beautiful fruit, growing on walls and rocks near Acharne.

Trichostomum glaucescens.—With great pleasure I found this beautiful glaucous moss in its native habitat. It is confined to the rock in Glen Fee, which is the only station in Britain for *Oxytropis campestris*. This rock occupies a small portion of the west side of the glen, and its composition is different from any other rock in the locality.

There has been much speculation as to the localisation, both of this moss and the *Oxytropis*, and Professor Geikie may throw some light upon the subject. Many mosses are very local, and are often confined to a particular formation, but I do not remember seeing the line of demarcation so well drawn as at the station for this plant, as after careful searching I could not find a single specimen upon the rocks immediately adjoining. The *Trichostomum* grows upon this rock in considerable abundance, and was fruiting fairly. In Glen Dole, I met nothing rare except a little bit of *Hypnum catenulatum*, which I have never gathered except in Canlochan Glen, in the same neighbourhood; but many commoner species were in great beauty, particularly *Distichium capillaceum* in fruit, and *Pterigonium filiforme* in luxuriant masses, several feet square, covering the trunks of trees near the rocks.

The Andræas were remarkably beautiful, covered with fine purple capsules; only *A. campestris* and *alpina* were noticed.

Conostomum boreale was found at the top of the crags. *Hypnum crista castrensis*, *Encalypta ciliata*, *Fissidens asplenioides* var. *polyphyllus*, *Rhabdoweissia denticulata*, *Grimmia Schultzii*, *Leucodon morensis*, and others not yet determined.

On our route by Bachnagairn and the head of Glen Dole to Little Gilrannoch, the principal object of search was *Grimmia unicolor*, known to grow on the rocks above Bachnagairn, but I only found one small patch. In passing the head of Glen Dole I searched for *Bartramidula Wilsoni*, without seeing any trace of it.

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3. *Geological Notes, by Professor Geikie.*

The main object of the geologists of the excursion was to observe some of the phenomena of the metamorphism of the district, to note the more prominent minerals, to trace the remains of old glaciers, and to connect the general structure of the rocks with the forms of hill, valley, crag, and ravine into which they have been carved. Incidentally, however, they took part in some of the botanical work, their attention being specially directed to the alpine flora, and to the circumstances under which some of the rarer alpine plants occur. There can be no doubt that, as pointed out by Edward Forbes, our alpine flora is descended from that which was general over these islands during what is known as the last Ice Age. It has been supplanted in the lower districts by the vegetation which has come in with a milder climate; and it survives on the bleak and cold mountain ridges only so long as it can find its congenial temperature there, or so long as the chills and mists of these high regions forbid the further ascent of the plants which, swarming over the country, have driven these northern forms step by step up into the high grounds. It is well known that the alpine flora is richer in individuals and in species in the eastern Grampians than anywhere else in Britain. A number of plants are found in no other part of the country, and even in that district several are restricted to isolated rocks in some glen or bare mountain brow. The question proposed to the consideration of the geologists was, whether any geological reason could be given for this remarkable distribution, and particularly whether or not the nature of the rocks had anything to do with it.

Some attention was accordingly paid to the habitat of three of the rarer and more local species. *Astragalus alpinus* was observed on hard quartzose schist high up in Glen Dole; the crag on which *Oxytropis campestris* flourishes is a mass of singularly twisted and gnarled fine quartzose gneiss, with hard siliceous ribs projecting from its surface, and showing the crumpled nature of the rock. But in neither of these cases does the rock apparently differ from many crags in the neighbourhood, where the peculiar plants, nevertheless, are not found. In the case of *Lychnis alpina* a special case

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seemed at first to be made out in favour of a relation, or at least coincidence, of a local plant with a local rock, for the locality noted as the habitat of this rare plant was found to present shattered knobs of serpentine projecting through the turf, and on these knobs the Lychnis grows, together with *Cochlearia officinalis* and *Armeria maritima.* This rock was not observed by the party *in situ* in any other part of the district examined. Before it was quitted, however, one of the botanists, who strayed further on the mountain, returned with a piece of mica-schist as the rock on which the same plants were found growing only a short distance away. It appeared, therefore, probable that, at the most, difference of rock can have had but a very slight influence on the survival and present distribution of the alpine flora.

A much more effective influence may be traced to the general physical geography of the country, and especially of the eastern as contrasted with the western districts. The richness of the Aberdeenshire and Forfarshire mountains in alpine plants, as contrasted with those of equal elevation in Inverness-shire and Argyllshire has long been a familiar fact to botanists. The cause of this contrast seems referable not to any difference in rock and soil, nor to any mere difference in height. It appears to be explicable by the much greater breadth of high ground in the east than in the west. Every one who has ascended some of the Grampian ridges remembers the wide undulating moors which seem to spread out before him at heights of 2000 or 3000 feet. The summits are not peaks, so much as huge swells or mounds rising higher than the rest of the vast table-land. In the western counties, however, the craggy mountains tower often into sharp ridges. They are deeply trenched by glens and arms of the sea, so that relatively a smaller area of land rises out of the ordinary lowland vegetation into the chiller regions above. Add to this that the Inverness-shire and Argyllshire hills lie nearer to the warm winds and currents of the Atlantic, and that the Grampian uplands receive the prevalent south-westerly winds after they have been chilled by passing over many leagues of high cold mountain ground. It is in these eastern parts of the highlands that snow lingers longest, widest, and deepest—a

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good index of the greater severity of the climate. These facts are suggested as affording a sufficient explanation of the comparative abundance of the alpine flora in that part of Scotland.

Why, in that limited district, certain plants should be restricted to mere isolated rocks, is a question to which no intelligible and satisfactory answer can at present be given. But even more perplexing is the problem presented by the survival of maritime plants upon some of the highest and bleakest mountain tops. In such positions the *Cochlearia*, or scurvy-grass, the *Armeria*, or sea pink, with *Silene maritima* and *Plantago maritima*, are found abundantly. They are poor dwarfed forms, it is true, when compared with their contemporaries on the coast, so that the latter habitat is evidently more congenial to them than the bleak uplands. They, too, are descendants of the old arctic flora, once indigenous in this country down to the sea-level, as it is in Northern Scandinavia at the present day. How have they come to be left on our mountain tops? Were they maritime plants originally, and have they been carried up by the gradual elevation of the land? This would involve a former submergence of the country to a depth of at least 4000 feet—a limit much beyond that suggested by other geological evidence. Or did they form part of the generally distributed flora, whereof some species, keeping to the shores, have been able, amid bare rocks and salt spray, to maintain themselves ever since, while further inland they have succumbed to the march of the invading Germanic flora, and have been allowed to struggle on in dwarfed and stunted forms only on the bare chill mountain tops, whither the invaders did not care to pursue them?

Some light might be cast on these questions by an examination of the contents of our older peat-mosses. There is reason to suppose that some of these mosses may date back to glacial times. It would be interesting to discover whether among the plants whose remains went to form the peat any northern species could be detected no longer living in this country, even in our alpine zone. This line of inquiry is now being prosecuted in Scandinavia, and it is suggested to the botanists of Scotland as a fit subject for their attention.

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III. *Notes on some Fossil Plants from the Shales of West Calder.* By C. W. Peach, A.L.S.

On 2d May I was at West Hermand Oil Shale Works, and in the "blasse," with which the bank for a small rail-road was made, at a new shaft, I found several fossil plants, one *Sphenopteris affinis* in a fine state, which I now exhibit fastened upon a glass-slide. Several other interesting plants turned up. One is very small, has a woody branched stem, and bears flower-like bodies, occasionally one on a stem, but most generally in pairs. The tips of the branches bend downwards, and to these the flower-like bodies are attached, hanging much like those of a Fritillary, with a divided perianth. I found *Sphenopteris affinis* in the same stone with it, but in no case do the two come in contact with each other. I look upon this as a very interesting plant, and although I do not say that it is a *true flowering* species, it greatly resembles one. Leaves and other organs are still required for full description. It is hoped that better specimens may ere long be obtained.

IV. *On a New Locality for Pothocites* (Paterson). By R. Etheridge, Jun., F.G.S.

At the April meeting (p. 151), the author brought under notice some specimens of *Pothocites* from the Lower Carboniferous series of the neighbourhood of West Calder. Since then he found in the Survey collection another specimen of this rare plant, obtained by the same indefatigable collector, Mr James Bennie, this time, however, from the altered and undulated shale of Barnton Pavement Stone Quarry, Corstorphine Hill. One of the former specimens exhibited showed that the stem of this plant branched, in addition to other characters, and that at the end of one of the branches was to be found an enlarged spike or strobilus similar to that originally mentioned by Dr Paterson. The present specimen exhibits another step in the organisation of *Pothocites*. Here we have what appears to be a main stem, of considerable thickness, terminated by the usual enlarged spike, and giving off a branch, which also bears another strobilus or spike, although, from the nature of the matrix, some of the other characters are not so well

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exhibited as in the former specimens; still we can distinctly see the node-like divisions of the spike, which in this case are three in number, and the three longitudinal ridges passing from the top to bottom of each node. Situated close to this specimen, but separated from it, is what appears to be another indifferently preserved head or spike. The vegetable matter of the stem in this specimen has been converted into some carbonised material, and has been split and cracked a good deal during fossilisation.

V. *Note on Fossil Cones from the Airdrie Blackband Ironstones.* By Geo. A. Panton, F.G.S.E.

(This paper has subsequently been printed in the Transactions of the Edinburgh Geological Society, vol. ii. p. 307.)

VI. *Report on the Open-Air Vegetation at the Botanic Garden.* By James M'Nab, Curator.

It has not been customary to report on the open-air vegetation beyond April; but as this spring has been unusually early, a few observations are made to contrast with seasons which may follow.

In one of my previous reports this year, it is stated, that from the comparatively small amount of continued frosts, also of snow and easterly winds, vegetation commenced early. Several of the plants selected for recording their flowering, which usually open their first blooms in January, and often in February, were noticed as flowering in December, thus blooming twice in one year—a circumstance which also happened during the early part of the winter of 1863–64, when ten of the selected plants were in bloom during December 1863 (see Bot. Soc. Trans., March 1864); no other case has happened with the same species of plants during the twenty-five years that I have recorded their dates of blooming.

Vegetation has continued to be from two to three weeks in advance of any season hitherto recorded, except the spring of 1868. With the exception of the Catalpa and locust tree, *Celtis occidentalis* or nettle tree, *Schubertia disticha*, deciduous cypress, and a few elms and beeches, most trees

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at this date (May 14) present a rich clothed appearance, while others are in all stages of advancement. Vegetation has continued to progress rapidly since last meeting, when I gave a list of many trees then in flower; amongst them the *Cratægus Oxyacantha* or hawthorn, as being partially in bloom, as well the *Cratægus coccinea.* These with others of the hawthorn tribe were in full blossom on May 1—a very unusual circumstance in Scotland, where, with few exceptions, they are seldom seen in bloom before the end of May or beginning of June. Besides the apple, pear, cherry, and gean, which were blooming abundantly about the middle of April, we had the *Prunus Mahaleb*, or perfumed cherry, in flower on the 20th April, the double flowering cherry on the 22d, the horse chestnut on the 24th, the lilac on the 25th, *Prunus Pattoniana* on the 26th, laburnum on the 30th, *Prunus Padus* or bird cherry on the 1st of May, *Glycine sinensis* on the 3d, superb scarlet flowering thorn on the 5th, and the *Pavia flava* on the 12th. This spring has been very favourable for the flowering of many hybrid rhododendrons, particularly the arboreous forms, such as *R. altaclerense* and *R. Russellianum*, and allied varieties, many of them blooming in the open air on the 26th of April.

Since the last meeting of the Society the thermometer has been ten times at and below the freezing point, viz., on the 11th, 12th, 13th, 15th, and 23d of April, also on the 2d, 4th, 9th, 11th, and 14th of May, each morning indicating 32°, with the exception of April 13 and May 9, when the thermometer fell to 28°, the highest morning temperatures being on the 20th and 21st of April, indicating 50° and 52°.

The subjoined table shows the number of degrees of frost registered below the freezing point from October 1 till April 30 for the last eleven winters, also the number of times at the freezing point for each year during the same period. This table cannot be looked upon as exactly correct, as slight frosts sometimes occur in September as well as during the month of May. It is useful, however, for contrasting one year with another.

From the table in question it will be seen that the winters of 1865–66, 1867–68, 1868–69, and 1871–72 show fewer degrees of frost than the one just passed, and yet not

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one of them, except the spring of 1868, exhibited unusual earliness of vegetation in April and May of these years. During the winter of 1865-66 a long snowstorm without severe frost, accompanied with strong north-easterly wind, may account for the small amount of frost recorded during each month and the average state of vegetation that season; while in the spring of 1868 trees and shrubs were all much earlier than any of those noticed in previous years. The selected spring plant list was also exhausted on March 28, while this year it finished on the 22d. Strong northerly gales, however, set in in April, and did considerable damage to the young foliage of trees (see Bot. Soc. Trans., May 1868). In the spring of 1869 vegetation advanced rapidly till the end of February, when it fell behind in consequence of a long continuance of frost and cold easterly winds. In the spring of 1872 vegetation was backward also, owing to the prevalence of cold easterly winds, but advanced rapidly after February 8, till again checked with the easterly winds which set in about the middle of March. In the present season (1874) no continued frosts nor cold easterly winds were experienced till the beginning of May; besides the past two months have been remarkably dry, and at times very warm, aided by westerly winds, which may account for the present forward state of vegetation when compared with those winters which show more moderate temperatures. Since May 1 up to this time (May 14) a continuance of strong north-easterly wind has been much against forward progress. Cold dry wind, with occasional frost at night, is beginning to tell on the early foliage, as well as on many tender herbaceous plants, besides blighting the blossom of the late flowering fruit trees.

This spring the swallow was first observed on April 18, and butterflies on the 26th; and frog-spawn was this year abundant in the pond of the Botanic Garden about March 26, while in 1873, as well as previous years, it was generally about April 16 before it was observed. The early appearance of the young birds and the premature movements of the tortoise, noticed at last meeting, seem to show that certain members of the animal as well as the vegetable kingdom are also in advance of previous years.

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Table showing the number of Degrees of Frost Registered at and below the Freezing Point (32°) *from October* 1 *till April* 30, *for the last eleven years, in the Royal Botanic Garden, Edinburgh.*

	Number of Degrees each Month the Thermometer was below the Freezing Point.								Number of Times at the Freezing Point, but not below, during the same period.
	Oct.	Nov.	Dec.	Jan.	Feb	Mar.	Apr.	Total.	
	°	°	°	°	°	°	°	°	
1863–64	10	35	50	394	165	71	12	737	16
1864–65	36	62	75	104	98	52	2	429	23
1865–66	21	43	16	40	38	66	7	231	20
1866–67	20	33	31	210	12	77	2	385	13
1867–68	8	40	41	75	10	29	10	213	17
1868–69	10	42	22	37	6	57	8	182	7
1869–70	12	58	119	76	74	50	19	408	13
1870–71	5	53	120	168	16	28	18	408	18
1871–72	24	39	59	42	13	23	5	205	13
1872–73	12	17	54	63	123	25	8	302	11
1873–74	31	35	36	32	69	37	6	246	14
	189	457	623	1241	624	615	97	3746	165

VII. *Miscellaneous Communications.*

1. Professor Balfour stated that, through the kindness of T. C. Archer, Esq., he had been able to supplement the large *Araucarioxylon Withami* in the Botanic Garden. The fossil tree now measured 30 feet 9 inches long. Circumference 3 feet from top, 57 inches; circumference at 45 inches from top, 66 inches; circumference at lower end, 12 feet 4 inches.

2. A note was read from Mrs Wright, Halston Hall, calling attention to some bricks taken from the old Roman walls at Wroxeter, not far from Shrewsbury, where the public baths of the Roman city of Miconium have been dug out. Some of the bricks were exhibited, filled with impressions of leaves.

3. Professor Balfour called attention to a plant of *Megacarpæa polyandra* (Benth.), in flower and fruit.

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11th June 1874.—Sir ROBERT CHRISTISON, Bart., President, in the Chair.

The following Candidates were elected Resident Fellows:—

Rev. JAMES FRASER, M.A.
JAMES LEITCH.
Rev. GEORGE M'ARTHUR, M.A.
DAVID NORRIE.
THOMAS B. SPRAGUE, F.R.S.E.

I. *Notice of a Pinaceous Fossil recently found in Redhall Quarry, near Edinburgh.* By Sir ROBERT CHRISTISON, Bart., President of the Botanical Society of Edinburgh.

An announcement having appeared about a month ago in the newspapers of the discovery of vegetable fossils in Redhall Quarry, I went to see them, and was shown, among others of less interest, a fine Sigillaria about six feet long and nine inches in diameter, and a much larger fossil, in which were easily recognisable the external characters of the great fossil trees of Craigleith.

This fossil was found near the west end of the New Quarry of Redhall. The principal beds of the quarry are a thick bed of sand and fine gravel, a little lower a thick bed of hard, fine-grained, white sandstone, and lower still a thick bed of softer, uniformly yellowish sandstone, also fine grained, and permanent in colour. Both above and below the white sandstone are thinner beds of a loosely aggregated and crumbly sandstone rock,—at one place a bed of loose sand and gravel about a foot and a half in thickness; and, between the upper gravel and another loose bed of sandstone over the hard white sandstone strata, there is at one place a singular six-inch bed of finely-comminuted peat, with ten or twelve feet of gravelly sand above it.

In various respects this quarry possesses geological interest. But I must confine myself to the special object of the present notice.

The principal fossil, and the only one I propose to describe particularly, is stated to have been found at or near

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the lower part of the white sandstone bed, where the strata dips towards 10° north of west, or nearly west by north, at an angle of inclination about 15°. It is represented to have lain horizontally in a direction at right angles to the direction of the dip of the bed. The thickness of rock above it could not have exceeded fifteen feet. Some of it had been removed before the attention of the lessee and foreman of the quarry was turned to it; and the rest, when I saw it, had been taken out of its matrix in four blocks, measuring together about ten feet. By the kindness of Mr Gowans, lessee of the quarry, these blocks have been presented to the Fossil Collection of the Botanic Garden, where they now lie. The foreman of the quarry is positive that no part of the fossil remains in its bed; and he is equally certain that nothing was seen about it of the nature of branch or root.

It is in form distinctly quadrangular, somewhat rhombic in its cross section, and rounded on the edges. The thickest part measures seven feet six inches in girth, and the thinnest segment six feet four. I was shown a quantity of bituminous coal, which is said to have formed a layer about two inches thick over the upper half of the fossil as it lay in its horizontal position. This is believed to have been non-adherent. But the entire surface of the fossil has been also covered, like the Craigleith fossils, with a similar bituminous coal, everywhere adherent, but very brittle and easily removed. Under this black shining coat, which seems to have been generally about a tenth of an inch in thickness, the whole fossil has the dull grey colour externally of the fossils of Craigleith. In texture it is extremely tough. The fractured surfaces are nowhere fibrous, but always curiously tesselated, so as to approach to a crystalliform arrangement; and they present a glistening, spangly, dark greyish-black appearance, almost metallic, and not unlike black mica-slate.

Fractures of this kind augur ill for the preservation of internal structure; because when the fossilising material asserts its own tendency to crystalline arrangement, it seems to push aside the vegetable textures, and condense them into black formless masses. Accordingly thin slices of the Redhall fossil show chiefly crystalline structure, and

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black shapeless masses without any appearance of organised texture. Nevertheless, in some small patches of these black masses, as exhibited in transverse sections, enough may be seen here and there of cells, regular or deformed, to prove that the fossilised substance had been exogenous wood belonging to the pine tribe.*

The resemblance of this fossil to those of Craigleith in chemical composition is remarkable. The external crust, as stated above, is a fine bituminous coal. It is of a jet-black colour, conchoidal fracture, and glassy lustre. Its density is 1·284. When exposed to a full red heat, it emits much smoke, which burns with a dense white flame; and at the same time it froths up, cakes firmly, and becomes a hard vesicular coke. When this is incinerated, there is left only 2·95 per-cent of a pale-ochre ash, which yields traces of iron to the action of nitric acid, but very little else; and no effervescence is visible, so that the ash does not contain any carbonate. The coaly matter, which is said to have lain abundantly, but unattached, over the upper part of the fossil, differs in no essential respect from the attached crust, except that its fractured surfaces are much less shining. Its density is 1·274. It flames when heated, cakes without frothing or swelling up, and yields 3·05 per-cent of ochrey ash, which does not effervesce with nitric acid.

The entire substance of the fossil beneath its coaly crust is totally different in nature and composition. It effervesces strongly with nitric acid; the solution becomes black as it proceeds; and at length the whole fossil matter disappears by solution, except a little, very fine, black powder, amounting to 3·25 per-cent, and consisting of charcoal, which presents all the familiar properties, not of coal, but of ordinary vegetable charcoal. The filtered solution is of a yellow colour, and yields by supersaturation with ammonia a large quantity of hydrated peroxide of iron; which, when thoroughly dried at a red heat, weighs 15·87 grains in 100 of the fossil. This corresponds with 23 grains of carbonate of protoxide of iron, which undoubtedly is the

* While this paper was at press, Mr Peach showed me small fragments of the same fossil, showing beautifully in transverse sections the usual cells unaltered in form, and in longitudinal sections medullary rays.

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iron-compound in this, as in the Craigleith fossils. The residual liquor, after separation of the iron, gives an abundant precipitate with oxalate of ammonia; and when this oxalate of lime is removed, the liquid gives with phosphate of soda a copious crystalline precipitate of phosphate of magnesia and ammonia. I did not ascertain the amount of lime and of magnesia thus obtained, because I found that, in different parts of the same Craigleith fossil, their proportion, and indeed that of iron also, varied considerably. No silica was indicated in my analysis. The fossilising material, therefore, consists of the carbonates of lime, magnesia, and iron, all in very notable proportion, and of a little free charcoal. This is precisely the chemical composition of the Craigleith fossils. Even the very proportion of charcoal is much the same, being 3·25 per-cent in the fossil of Redhall, and 2·9 from an experiment on a large scale with the fossil found most recently in the lowest part of Craigleith Quarry.

Three circumstances render this remarkable chemical composition interesting. It is quite different from the composition of the rocky bed in which the fossil has been formed. It is equally different from that of the Sigillaria, and other fossils found in the same bed with it. And the interior of the fossil is quite different in composition from the thin crust which surrounds it.

The white sandstone of Redhall is much softer than that of Craigleith, more easily broken, much more easily reducible to a coarser-grained sandy powder, and consequently much more easily worked both by quarryman and mason. It has a density of 2·426, which is very nearly that of the Craigleith stone,—2·45. The powder does not show even the most minute vesicle of effervescence with nitric acid moderately diluted. This acid, however, reduces its weight by 1·5 per-cent. The solution gives with ammonia a very scanty precipitate of peroxide of iron, then with oxalate of ammonia a little oxalate of lime, and lastly with phosphate of soda a still scantier crystalline precipitate of ammonio-magnesian phosphate. When the solution, deprived of iron, is supersaturated with nitric acid, nitrate of baryta causes a scanty precipitate of sulphate of baryta, proving that the lime, at least, is present in the sandstone in the form of sulphate. The white sandstone, therefore,

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contains traces of lime, magnesia, and iron, not in the form of carbonates. Consequently it is a very pure siliceous sandstone. The proportion of foreign ingredients is so small, that they can scarcely play the part of a binding material. The sandstone has been formed by simple accretion of its sandy particles, not by agglutination with a medium. The yellow sandstone of Redhall has a very pale yellowish hue, which is uniform, and not apt to become blotched with age and exposure. It is even softer than the white stone, and is reducible to sand in a mortar with great facility. Its density is 2·39. The action of nitric acid is quite the same in kind in all respects as in the case of the white stone; but the loss sustained in weight is only 0·7 per-cent or half the loss sustained by the other. Hence this, too, is sand converted into stone by accretion, not by agglutination.

Turning the attention now to the Sigillarias, and other vegetable fossils whose original vegetable structure is known to have been visibly cellular, not woody, it is apparent to the naked eye that the fossilising material is simply the surrounding sandstone of the bed in which they are found. Chemical analysis confirms what the eye assumes. The material is reducible with great facility to a sandy powder. With this powder nitric acid slightly diluted does not occasion the faintest effervescence. But it takes up a mere trace of lime, magnesia, and iron, as indicated by the successive action of ammonia, oxalate of ammonia, and phosphate of soda. The loss thus sustained is 1·62 per-cent. But part of this loss is due to moisture; for inadvertently the material was not thoroughly dried before analysis. The composition is evidently the same with that of the sandstone beds of the quarry. Hence the fossilising process is evidently simple. The sand, before accreting, penetrated into the vegetable texture, and, as that decayed, took its place. In the course of time, both the sand of the bed, and that within the fossils, underwent by slow degrees conversion into sandstone rock. And hence the only structure preserved is on the outside, which forms, as it were, a mere cast of the plant. So far as I saw, none of these fossilised cellular plants had any coaly crust on their surface. The Sigillaria now in the Botanic Garden had none; nor could

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any be traced on the inner surface of its sandstone mould, of which several large fragments were shown to me in the quarry, and one has been removed to the Garden.

The third peculiarity in the composition of the fossil is the remarkable difference in this respect between the great internal mass of the fossil and its outer covering. The latter is a brittle coal, without any trace of vegetable structure, and consists of about 97 per-cent of combustible matter, highly bituminous, and about 3 per-cent of earthy matter, without any carbonate. The former, on the contrary, is a hard tough stone, showing distinctly the structure of exogenous wood; and it is composed of about three per-cent of combustible matter, which is charcoal destitute of bitumen, and 97 per-cent of earthy matter, which is all a mass of carbonates. Here the process of fossilisation is evidently quite different from that of the Sigillaria and other fossil vegetables in the quarry. The sandy particles could not penetrate the dense fine-grained pinaceous wood. Fossilisation must have been effected through means of the gradual percolation of water, containing lime, magnesia, and iron in the condition of carbonates. But how are we to account for the charcoal within the fossil, in contradistinction to the coal on its exterior? The obscure process of the formation of coal in general has obviously some concern with this question.

The history of the Craigleith, Granton, and Redhall fossils,—for they all belong to the same category,—may be inferred to a certain extent with confidence from their site, state, structure, and composition.

In the first place, they are certainly water-borne. In their progress from the place where they grew to the place where they have been found, they must have undergone very rough usuage. For their roots have been destroyed; their branches have been so completely lost that not even a stump remains attached; and they have been stripped of their bark,—because, as I have shown elsewhere, the common notion, that the coaly crust of such fossils represents the bark of the converted trees, cannot apply to those, at least, which are now under consideration.

The distance of the three quarries from one another points to the agency of a great expanse of water. Craig-

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leith is two miles from the shore of the Forth, where Granton Quarry now lies submerged in the sea; Redhall Quarry is two miles and a quarter from Craigleith, and four miles from Granton; and all three lie not far from a right line in relation to one another.

The trees must have belonged to the pine tribe. I do not venture now to go into the question of their species. Witham thought there were two species in Craigleith, and named them. This is not impossible. But I doubt whether the data, limited to the microscopic woody structure, are sufficient to settle this point. At any rate it can scarcely settle the species of the Redhall fossil, since its microscopic structure is too deformed and obscure. It seems certain, however, that all the fossils of the three quarries had been pines of a fine, dense, close-grained organisation.

If the width of annual woody rings in the pine tribe be any index, as some think, of the quality of the climate in which they grow, the original trees of these fossils must have been reared in a more genial clime than the one in which their stony representatives has for long ages reposed. In two specimens the boundaries of the annual rings are distinctly shown to be from a tenth to half an inch in breadth; and in one of these, five inches in width, the whole of this space is sharply shown to be occupied by nine annual rings.

The trees must have settled in their bed while its material was either undergoing gradual deposition, or existed as a quicksand through which they could gradually sink,—their lower, heavier end foremost.

Here in the course of ages they have been changed by a very peculiar process. One part of the process has been the petrifying agency of water containing carbonate of lime, magnesia, and iron, parting with its mineral ingredients to the organic structure which it has slowly percolated and displaced. We are not confined to the fossils themselves for proof of this percolation. To a considerable distance around them, and also in sundry places far away from them, the otherwise pure quartzy sandstone is converted into a calcareo-ferruginous sandstone, quite different in external characters, and quite different in composition, inasmuch as it contains from 7 to 39 per-cent of the very mineral ingredients which build up the fossils. This, at

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least, is certainly the case at Craigleith and at Granton; and I have little doubt that the same holds true at Redhall, for I could see many fragments lying here and there which had the external characters of the calcareo-ferruginous Craigleith rock,—being hard, grey, in fracture splintery, and under long exposure becoming ochrey. I have not yet analysed any of these altered sandstones,—a want, however, which will be supplied.

But what of the charcoal diffused in impalpable powder through the whole interior of the fossils? And what of the coal which covers their outer surface? I can find but one satisfactory explanation. Organic matters, exposed to atmospheric air at ordinary temperatures, undergo change and decay by a natural process of very slow oxidation, analogous to the swift oxidation in the air, aided by strong heat, which constitutes ordinary combustion. To this slow, spontaneous process Liebig gave the convenient name of "Eremacausis." The products of fossilisation, in the instances before us, point to a parallel, slow, natural process of distillation, or "Eremapostaxis." In the ordinary process of the destructive distillation of wood, in close vessels, at a low red heat, the results are water and bituminous matter in the receiver, and charcoal left behind in the retort. So by an imperceptible destructive distillation at ordinary temperatures, under exclusion of atmospheric air, carried on very slowly in these vegetables, we have precisely similar products:—Charcoal remaining behind, and bituminous matter passing out with the water, and allowed to collect on the surface owing to the extreme slowness of the whole process.

I am by no means wedded to this theory, however, and will cheerfully exchange it for a better.

II. *Remarks on Specimens of Ulodendron and Halonia, collected by Messrs Galletly and Lumsden, near West Calder.* By C. W. Peach, A.L.S.

Mr Peach exhibited specimens of *Lepidodendron*,—one, although a fragment, was 18 inches broad, showing that it belonged to a large tree. He then referred to a series of specimens of *Halonia regularis*, some in excellent preserva-

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tion, one more than 5 inches across. They showed various scar markings, besides branches, bark, and leaf scales. He alluded to the various opinions of palæo-botanists as to their true nature, Dawes, Hooker, Binney, and others, saying they were roots; Dawson, *Stigmaria* of Lepidodendron; whilst Carruthers, in Geol. Mag., vol. x. 1873, says—"I have no doubt that *Halonia* was a fruit-bearing branch;" and so at present the controversy rests. Such specimens as those now produced throw light upon some of the disputed points. *Ulodendron minus*, he said, was well known, from the description given by the late Hugh Miller. The specimen of *U. majus* must have belonged to a large tree; though only a fragment, and showing only one scar, it is 13 inches across. He next exhibited a specimen of *Ulodendron ovale* of Carruthers; scars large and well defined; leaves long, broad, and thickly placed. This has in addition a branch springing under a large scar on the right side with leaves. The only other branched specimen known is that of Hugh Miller in the Museum of Science and Art, Edinburgh. Another specimen had large scars like those mentioned, but differed from all he had seen or heard of, in having a double row of scars. They were large, arranged in a semi-alternate manner, leaves short and stiff, forming dense masses over the upper part of the large scars. Under the bark are irregular hexagonal plates, with a small tubercle in the centre of each, to which in all probability the leaves were attached before passing through the bark. He hesitated to give it a new generic name, considering it to be only an abnormal form of *Ulodendron*. He, however, believed it to be a new species, and proposed provisionally *U. scoticum*, to mark whence it came. He concluded by showing a large stem of a branched plant, having a thick woody centre. It took as fine a polish as jet. Although unable to get sections for the microscope, the external structure could be well seen from the fibrous matter filled by pyrites. All the specimens were in a fine state of preservation.

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III. *Remarks on the Fossils exhibited by Mr Peach at the May Meeting, and which seem to belong to the genus* Staphylopteris *of Lesquereux.* By Professor Balfour.

Professor Balfour stated that the fossil plants exhibited by Mr Peach (see p. 162) seemed to belong to the genus of ferns called by Presl *Staphylopteris.* Species had been found in the Tertiary formations of Europe. Leo Lesquereux had also detected specimens in the Coal Measures of North America; these had been named *Staphylopteris Wortheni, S. asteroides,* and *S. sagittatum;* and are described in vol. iv. of the Geological Survey of Illinois, of which Mr A. H. Worthen is director. The fructification seems allied to that of *Botrychium* or *Anemia.* It consists of small rounded or elliptical sporangia, opening at the top apparently by numerous valves. If the species observed by Mr Peach in the secondary rocks near Edinburgh has not been described, it ought to bear the name of the discoverer, one of the most active and zealous palæontologists.

IV. *Report on the Open-air Vegetation at the Royal Botanic Garden.* By James M'Nab, Curator.

On May 14 I noticed the advanced condition of many species of forest and ornamental trees, in consequence of the mild weather of March and April. Early in May cold dry easterly winds set in, and continued almost incessantly to the 24th, when we had a few heavy showers; the wind afterwards became variable, attended with violent gusts, chiefly from the west. During the first three weeks of May vegetation seemed almost stationary. The foliage of the trees, and the flowering of many herbaceous plants, had made little progress, while the early flowers of several species suffered much. On the first of June many hardy ornamental trees were either leafless or far behind, such as Catalpa, deciduous cypress, locust tree, deciduous magnolias, tulip tree, American plane, sugar maple, American oaks and ash trees, various species of *Gleditschia, Planera, Ostrya, Celtis, Juglans,* and *Garrya;* also several not American, of which the foliage was only partially developed in the beginning of

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May, such as the beech, common ash, elm, walnut, chestnut, certain poplars, hornbeam; also the oaks, except, however, the *Quercus pannonica*, which notwithstanding has had its splendid foliage fully matured for some time. The weeping ash, like the American trees noticed, showed little sign of leafing till after June 1. This tree is always later than the parent species (*Fraxinus excelsior*) which produced it.

The premature blooming of many ornamental trees and shrubs, such as thorns, lilacs, varieties of sorbus, common gean, and horse chestnuts, seems to have been brought to a standstill during May by the cold. Although many of them flowered profusely, they did not assume that showy appearance which they would have done had they not been prematurely stimulated by the previously mild weather. The so-called English laburnum (*Cytisus Laburnum*) was early in bloom, and its blossoms were injured and bleached with low temperatures and the cold east winds of May, while the so-called Scotch variety (*C. Laburnum alpinus*), being later, did not suffer, and was in its best condition on June 1, showing its hardiness compared with the other.

A large proportion of the late leafing trees in this country are of American origin, and are not in the habit of starting into leaf till the season is well advanced. Notwithstanding the remarkably mild weather of March and April, they made no effort this year to leaf earlier than usual, probably owing to the want of frost at the time they are accustomed to it in their native localities. If these trees had been subjected to severe frost in January and February, I feel assured that they would have been further advanced than they were on June 1. The vernation of American and other trees with reference to the previous winter's temperature, and their period of flowering and fruiting, should be recorded by arboriculturists. Similar observations should also be made on British forest trees, and the ordinary fruit trees grown in this country.

It is well known that many hardy plants make slow progress if put into heat before being exposed to frost, while the same species, if subjected to frost for eight or ten days, will rapidly burst into leaf and flower when artificial heat is applied. The same may apply to the American trees alluded to.

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The warm weather experienced since June 1 has caused vegetation to make rapid progress, few trees being now leafless (June 11); the Catalpa is amongst the latest.

Many herbaceous plants annually procured at this time for class examination purposes, are only partially in bloom. The mild winter, and the weather which has succeeded, have been conducive to the spread of caterpillars. The early leaves of the elm and lime, the apple, rose, gooseberry, and currant are much infested with them.

Since May 14 the six lowest points of the thermometer were on the mornings of May 15, 16, 17, 18, 21, and 29, indicating 37°, 32°, 29°, 34°, 38°, and 36°; while the six highest morning temperatures were on May 31, June 1, 2, 5, 6, and 7, indicating 51°, 52°, 56°, 54°, 55°, and 52°.

V. *Miscellaneous Communications.*

1. *Spanish Plants.*—Professor Balfour called attention to several Spanish plants recently found growing on the banks of the Water of Leith between Currie and Colinton, about 5 miles from Edinburgh. Specimens of these were exhibited. They are principally Grasses and Crucifers, including *Brassica Bœtica*, *Sisymbrium arundanum*, *Eruca sativa*, *Ægilops triaristata*, *Bromus madritensis*, *B. tectorum*, *Dactylis hispanica*, &c. Mr Sadler stated that the occurrence of these plants was probably due to the introduction of their seeds with Esparto grass, now extensively used in the paper-mills on the Water of Leith.

2. *Hybrid Alpines.*—Mr M'Nab exhibited a large collection of Alpine plants in flower. One was raised from a Scotch specimen of *Erigeron alpinus*, the seeds of which had been ripened near a plant of *E. Roylii*. A number of seedlings now flowering freely, are strong branching plants about 12 inches in height. Another hybrid was raised from seed of *Oxytropis Halleri*, ripened near a plant of *O. campestris*. The seedling has a slight resemblance to *O. campestris*, but has yellow petals, tinted with purple.

3. *Transmission of Seeds.*—Mr M'Nab stated that a stone bottle had been received at the Botanic Garden from Dr Little, Singapore, containing seeds of a Caryota, and a new species of Areca. The bottle was filled with moist

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soil, and the seeds arranged in layers. The Caryota seeds had commenced to germinate. Some palm seeds (*Corypha elata*) from Dr King, Calcutta, packed in brown paper, were hard and dry, and will be longer in vegetating than seeds sent in moist soil.

4. *Newbattle Beech.*—Sir Robert Christison, Bart., gave a short notice of this remarkable tree. The trunk rises about 20 feet before giving off branches, and then rises with a certain methodical irregularity, carrying a great girth to a great height. It is difficult to describe this upper trunk. The branches appear rather to form the trunk than to rise out of it, constituting as it were a part of the trunk some way up before taking their outward course as true branches. The extreme branches are everywhere covered with fine twigs, showing that the whole tree is healthy and thriving. During a late hurricane a huge limb was snapped off, but there are so many more that its loss is scarcely noticed. At 2 feet from the ground the buttresses make the girth 32 feet; at 5 feet it is 21 feet; and at 7 feet, the narrowest part below the first branch, it is 18 feet in girth. The great massiveness and height of the trunk produce a sort of oppression on the inner sense of the spectator. On the whole, it is more gigantic than the Eccles Beech, chiefly perhaps on account of the much greater length of trunk before its first branches come off. It is undoubtedly taller, and in every way an object well worth going a long distance to visit.

5. Professor Balfour exhibited a collection of dried plants from Kerguelen Island, recently received for the University Herbarium from the officers of the "Challenger" expedition. Among the species received were:—*Ranunculus crassipes*, *R. hydrophyllus*, *Pringlea antiscorbutica*, *Azorella Selago*, *Colobanthus Kerguelensis*, *Leptinella plumosa*, *Lyallia Kerguelensis*, *Triodia Kerguelensis*, and *Lomaria alpina*. Several bottles containing seeds of Capt. Cook's Cabbage (*Pringlea antiscorbutica*) had also reached the Botanic Garden, and they were germinating freely.

6. Mr Sadler called attention to the two forms of *Fragaria elatior*, and exhibited flowering specimens showing their dicœcious character.

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9th July 1874.—Sir ROBERT CHRISTISON, Bart., President, in the Chair.

The following Candidate was elected as a Resident Fellow:—

Rev. WILLIAM MURRAY M'DONALD, Burnhead, Thornhill.

The following Communications were read:—

I. *Notice of a Remarkable Polyporus from Canada.* By Sir ROBERT CHRISTISON, Bart.

A short time ago I came accidentally upon a mysterious specimen,—mysterious, I mean, to myself,—which I had put aside in 1843 till I should receive further information about it, and of which I had lost sight during other and very different pursuits. The label on it bears that it is "a fungus from the white pine" of Canada, presented to me by Dr James Johnston, at the time assistant-surgeon in the 71st Highland Light Infantry. On presenting it to the Botanical Museum, I found that it seemed as novel and strange to Dr Balfour and other experienced botanists as it was to myself; but a small fragment, evidently of the same kind of substance, was subsequently found in the collection at the Garden.

As a cursory examination proved it to be an object of interest, I applied to Dr Johnston for further information; and fortunately, considering the long period which has elapsed since he parted with it, he was able to turn up in a memorandum-book the following note, taken on April 28, 1841, when he got it at "Penetanginshine, Georgian Bay, Lake Huron," viz., "Bought a wahbodo,—Indian rhubarb, —a fungus growing on top of white pine,—very scarce—thirty-three years' growth. Indians say it lives—cries like a child—bleeds when wounded—and does not fall unless killed. This specimen was brought down by three rifle-balls. A tonic bitter—recommended as an application to wounds. It was brought to me a distance of upwards of 50 miles."

The wahbodo is still in perfect preservation, as when I

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got it thirty-one years ago. It is 18 inches long, from 22 to 26 inches in girth, firm in external texture, and very fibrous, the fibres longitudinal. It is very white. It weighs thirteen pounds. It is strongly marked by thirty-three parallel rings, or seems to be made up of so many circular superimposed cakes, somewhat more than half an inch in thickness. At one side of its thicker end there is attached, over a space as large as the palm of the hand, a quantity of the outer bark of a smooth-barked pine. On cutting out with the saw a quarter section along its whole length, it was found that the rings outside penetrate a very short way inwards; that the texture everywhere is in general spongy, white, and fibrous; but that there are also many long, longitudinal, rudely parallel lines on the surface of the section, which are brownish, harder, not at all fibrous, and which obstructed the saw by adhering to it like resin. The powder has a strong, pure, almost aromatic, bitter taste, very like that of sulphate of quinia.

Dr Maclagan made a rough analysis of it for me, and found that it consists, in 100 parts, of 64·59 resin, 25·79 cellulose, and 9·62 watery extract. The bitterness he found to reside, not in the resin, but in the watery extract, and therefore it must depend on some other proximate principle, possibly crystalline.

On consulting the most eminent English authorities on the fungi, Dr Balfour found that all considered this substance, from an examination of small fragments only, to be ligneous texture degenerated and much altered by the presence of a species of Polyporus, which Mr Berkeley thinks will probably prove to be *P. Pini canadensis* (Schweinitz).

II. *Notice of some Trees recently Struck by Lightning.* By James M'Nab.

I recently examined a large sycamore in the park at Woodburn, Dalkeith, which was struck by lightning on June 25. The stem is eleven feet in circumference at 3 feet up, about seventy feet in height, and of perfect symmetry Considerable portions of the outer bark, varying from 2 to 3 feet in diameter, particularly on various parts of the upper branches, seem to have been

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scorched—pieces from 1 to 6 inches in length, and averaging about 2 inches in breadth, being more or less curled up, some appearing as if attached by the middle. Only on one spot is the bark removed down to the wood; this space is 2 feet long and 6 inches across. The lower part of the main stem shows numerous lines on the outer bark, as if removed while the electric fluid was passing to the ground. At the time of the lightning two bullocks standing close to the stem were killed. It is difficult, as yet, to say what permanent damage the tree has sustained; the upper portion has a yellowish appearance, particularly on the south-west side.

Dr Ballantyne, Dalkeith, informs me of an ash at Lugton, on the Dalkeith property, which was struck by lightning during the same storm. This ash is 8 feet in circumference, and 50 feet in height; the main branch was struck about one-third from the top,—at this point the bark is entirely gone, and the wood much splintered. At various places along the main stem the bark is more or less stripped off, and on the lower part the bark is nearly gone all round. The stem is covered with longitudinal fissures, but no splintering is seen except on the part first struck. Various trees are reported as having been injured by lightning on the same day, both in Fife and Mid-Lothian.

On hearing that some beech plants were injured in the grounds of Messrs Methven & Sons, at Inverleith Park, on June 25, I made an inspection of them, and found a row, 39 yards long, with plants averaging from 2 to 3 feet in height, which had stood in their present position for four years. The leaves of nearly all appeared burnt, but the plants did not seem to have sustained further damage. A large group of elms, about the same size, stood close to the beeches, but none of them appear to have suffered. About 50 yards distant there are numerous beeches of the same age, but none of them showed signs of injury. I have long been anxious to ascertain the precise damage done to large beech trees by lightning in this country, from a prevailing notion in America that this tree is never struck, and is therefore resorted to by the rural inhabitants during thunderstorms. Several instances in Britain are known to me of beech trees having been injured in leaf

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and bark, but in no case killed by being split or torn to pieces like other trees, such as oak, elm, ash, silver fir, &c.

Of recent years forest and ornamental trees damaged by lightning have been numerous. Many trees, although not torn to pieces, are often injured to such an extent as ultimately to cause death. During spring large branches are found to be dead, and often the whole tree, evidently the effects of lightning during the previous summer or autumn, not observed at the time.

Wall-fruit trees are also subject to the effects of lightning; the injury is almost immediately observed by the sudden browning of the leaves. In the case of stone fruits, besides being browned, bursting of the bark often takes place, causing gum to ooze from the injured portions.

III. *Botanical Notes.* By John Lowe, M.D., Lynn.

1. *Note on mounting Hepaticæ.*

A plan which I adopted many years ago has been found to answer so well for preserving the delicate Hepaticæ that it may be worth while to record the method of procedure for the benefit of those who may be commencing this most interesting study. It affords not only a means of preserving the specimens more perfectly than any other, but it also enables the student to refer to them for comparison, which he cannot do satisfactorily when they are mounted in the ordinary way without detaching them from the paper and soaking them in water.

The first requirement is some tolerably strong paper (in order to avoid curling) of smooth surface, and colour to match the herbarium sheets; this is to be spread evenly with gum and allowed to dry, when it is cut into small square-shaped pieces ready for use. It is better to have a set prepared with very thin gum for the more delicate forms. The specimen having been thoroughly freed from dirt—if necessary by washing—is pressed gently between blotting paper, in order to remove superfluous moisture. It is then placed on the paper, and firmly pressed for a few seconds with the point of the finger covered by a cambric handkerchief. The plant will then be found to have adhered to the gummed surface. After carefully removing all trace of

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moisture, the paper is next to be placed in clean blotting paper, and pressure applied until it is dry.

It is well, in order to avoid confusion, to write the name of the specimen on the back of the paper before mounting it.

2. *Clathrocystis æruginosa* (Henfrey).

Henfrey observes (Trans. Mic. Soc. vol. iv.), "This remarkable form does not appear hitherto to have been found in Britain. We found it in the autumn of 1855, forming a scum extending over a large portion of the lake in the Royal Botanic Gardens at Kew."

In June 1870 I noticed that the entire lake at Sandringham was coloured a bright grass-green by some minute alga, and on examining the water microscopically found that it was full of this beautiful plant. It occurred to me that aquatic plants might possibly have been brought from Kew, and the alga thus introduced, but a careful inquiry has satisfied me that this is not the case. The lake is of recent construction, and there have been no aquatic plants brought from a distance.

Currey figures a very imperfect form, which, he says, differs from Henfrey's figure in the much greater number of reticulations (Mic. Journal, vol. vi.) This is evidently due to the greater age, as the reticulations increase in number and size as the plant becomes older. The cellules, which become brown in autumn, and free, as Henfrey describes, have a diameter of $\frac{1}{2000}$th of an inch. In September the frustules are surrounded by extremely fine filaments of Spirillum, which, during the earlier part of the year is not seen in the lake.

The peculiar verdigris green which the *Clathrocystis* presents on drying, is very marked and characteristic.

3. *Asplenium Adiantum-nigrum* var. *A. acutum* (Bory).

Specimens of this plant were brought to me by Mr B. Bray, who discovered them on a common near Lynn. They evidently correspond with *Adiantum acutum* in all particulars, though the pinnules are not quite so alternate as in a specimen from Teneriffe, which was kindly

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forwarded to me by Mr P. N. Fraser. In this neighbourhood the habitat is so wild, and the amount of the plant so considerable, as to preclude the idea of its having been introduced.

IV. *On the Open-Air Vegetation at the Royal Botanic Garden.* By James M'Nab, Curator.

Since last meeting (June 11) we experienced during the early part of the month much cold, dry easterly wind, with hot sun, which has kept back the foliage of late-leafing trees, such as sugar maple, locust tree, deciduous cypress, tulip tree, catalpa, liquidambar, deciduous magnolias, &c. Owing to the long drought the leaves of several species look as if they would not be properly developed this season; they are now (July 9) far behind. We had heavy showers of rain on June 25 and 29, and slight showers on several days since, but the moisture not having penetrated the soil under the trees, a full development of foliage cannot be expected.

The long dry weather has ripened the leaves of some early-foliaged trees, such as the lime and sycamore, which, in several town squares and gardens, already display an autumnal tint. Excluding the common horse chestnut, elm, lime, and sycamore, few of the ordinary forest trees, as the beech, ash, oak, and birch (except in situations naturally damp), show the usual rich luxuriance of foliage of the beginning of July; and from present appearance, particularly in dry situations, do not seem as if they would attain their accustomed size this year.

The double-flowered English cherry (*Prunus avium*) bloomed a second time about June 20, probably from buds of the first flowering partially injured by the east wind in spring.

Scarlet-flowered horse chestnuts have been very late, and none of the flower-heads equal those of former years.

A large old service tree in the Botanic Garden has assumed a remarkable appearance this year. The stem is 4 feet 6 inches in circumference, and 8 feet high before branching. It is on a raised bank, and a grass lawn rises close to the stem on one side, while the ground on the opposite side is covered with shrubs of yew and lilac. The

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leaves on the branches next the exposed grass-bank were fully developed three weeks before the leaves on the root-bound portion, which forms about one-third of the tree. The latter is now covered with rich foliage, but shows no appearance of flowering; while the former is abundantly set with fruit, and has foliage of a dark green colour. This shows that the roots on one side do not stimulate the branches on both sides at the same time.

The blooming of late varieties of rhododendron has been inferior this year, owing to the dryness of the soil; few of the flowers became freely developed, and except where water was freely applied, many decayed without opening.

Since the rain on June 25 and 29, the young growths on conifers have made rapid progress, and promise to equal those of former years.

Since last meeting the six lowest morning temperatures were on June 12, 14, 15, 25, 26, and 30, indicating 34°, 40°, 36°, 38°, 38°, and 41°; while the six highest morning temperatures were on July 1, 2, 3, 4, 8, and 9, indicating 54°, 55°, 55°, 53°, 53°, and 53°.

V. *Notice of a Crab-Apple Tree of unusual size at Kelloe, Berwickshire.* By Sir R. Christison, Bart.

When visiting, three weeks ago, a friend at Kelloe House, in the parish of Edrom, a few miles eastward from Dunse, I was shown a Crab-apple tree, which appears to me to deserve being added to Mr M'Nab's memoranda of large trees in Scotland. Crab-apple trees are more frequently met with in the hedge-rows in Berwickshire than anywhere else in Scotland where I have been; possibly, because nowhere else in Scotland do hedge-rows abound as fences. The tree in question, according to the information supplied by an old man upon the estate, stood with several others in a hedge-row, but the hedge was cut down to improve the highway. This particular tree was, however, so large, even at that time, very many years ago, that it was left standing in a convenient triangular space, in front of Kelloe gate, where it does not interfere with the roadway. It has now a trunk of 8 feet in girth, is 50 feet in height, branches freely, and was covered with leaves when

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I saw it. The fruit was clustered, as in the cherry. In the spring the whole tree was one sheet of white flower; but little fruit formed, in consequence of our sharp frosts in May. It is well known in the surrounding country, whose inhabitants visit it from a considerable distance when it is in flower. It continues to be perfectly healthy in every part.

VI. *Remarks on Specimens of some Fossil Plants.* By Charles W. Peach, A.L.S.

Mr Peach exhibited the following specimens of fossils:—(1.) *Sphenopteris affinis* with circinate vernation and fructification, and apparently with a stem of *Staphylopteris* attached to it. (2.) Upper part of a cone of *Lepidodendron* with microspores, found in the sandstone cast of a Sigillaria from Addiewell Works, near West Calder. Mr Peach remarked that he could not find in works on British fossils any record of a plant with circinate vernation. He had, however, met with a well-marked specimen of *Sphenopteris affinis* in that state in shale at West Calder. He also found the same species with fructification on the back of the fronds. He also stated that he had suspected that *Staphylopteris*, a new genus which he had met with, clung for support to *Sphenopteris affinis*, and on the 20th ult. he got a slab showing these plants so united. Another fossil plant so clinging, but of a different genus, was figured in Lindley and Hutton's Fossil Flora, vol. ii. pl. 100 and 101, showing that this was not the only climber in carboniferous times. The plants on the stone he procured were in a sadly shattered state, showing a wintry appearance, the *Sphenopteris* being denuded of every frond, and its rachis sadly shattered. He added that the first specimen shown, viz., in circinate vernation, told of spring—that in fructification of summer and autumn, and the last indicated winter. He described a fossil cone found in the sandstone cast of a *Sigillaria* from Addiewell, stating that in addition to its crown of bracts, sporangia, &c., it showed beautiful microspores, which still retained their colour and amber-like appearance. The remarks were illustrated with sketches and specimens.

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VII. *Miscellaneous Communications.*

1. Dr Balfour gave some account of botanical trips to different localities round Edinburgh, and noted the principal plants met with. At Craufurd Priory, near Springfield, *Herniaria glabra* was discovered by Mr R. A. Lundie for the first time in Fife. In the same district *Ornithopus perpusillus*, *Rhinanthus major*, *Teesdalia nudicaulis*, and *Geranium columbinum* were collected.

2. Professor Balfour noticed the flowering of *Plectocomia elongata* in the palm-house of the Botanic Garden. The male flowers are produced in long scaly spadices from 2 to 3 feet long, hanging from a common rachis, and have a powerful sweetish odour. The palm is about 70 feet in length.

3. Professor Balfour exhibited a remarkable monstrosity occurring in the common wallflower received from Dr Brodie of Liberton. In this specimen the siliqua appeared as a narrow stalk, sometimes dilated at the upper part into a flattened portion, resembling the normal siliqua, and beyond this it was prolonged so as to form one of the divisions of a lomentaceous legume, ending in a style and stigma. The lomentaceous portions opened on one side, and produced flowers with sepals, petals, stamens, and carpel like the Cruciferæ. The flowers proceeded from the placenta, and there were no seeds in the lomentaceous portions. It would appear, therefore, that the abnormal portion of the siliqua, in place of containing a seed or seeds, gives rise to a cruciferous flower with all its parts.

4. Mr A. Stephen Wilson sent for exhibition living fructifying specimens of *Claviceps microcephala* (the Ergot Fungus), and gave some particulars as to its mode of growth.

5. Mr J. F. Duthie called attention to specimens of *Polygala oxyptera*, Reich., which he had recently collected in the King's Park at Stirling, and exhibited specimens in flower of a hybrid *Sarracenia* between *S. flava* and *S. Drummondi*, raised by Dr Moore, Glasnevin, Dublin.

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PROCEEDINGS AND TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

SESSION XXXIX.

12th November 1874.—Sir ROBERT CHRISTISON, Bart., President, in the Chair.

The President delivered the following address:—

An unlucky, ill-timed illness during the week immediately preceding the commencement of my winter University duty deprived me of the leisure on which I had counted for preparing an Address this day worthy of my position here, and of the audience to whom it was to be delivered. I have not been able to command time and opportunity for preparing the customary obituary notices of the Fellows who have been removed by death from our Society during the past twelve months; but this deficiency will be yet supplied. I have found it impossible to undertake the discussion of any general topic of botanical interest. But fortunately a subject of great local interest to this Society, and to the advancement of botanical study in this city and country, has somewhat suddenly turned up, on which it may be of some little use that, as your president, I should at present express views in which I have not the least doubt that the members of the Botanical Society will generally concur with me. This is the necessity which has arisen for the further extension of the Royal Botanic Garden.

It will probably astonish even some of ourselves, and

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perhaps at first repel those official persons who consider it their primary duty to defend the public purse against all comers, especially, who attack it in the name of science,—to be told that the first garden applied to the purposes of botanical science in Edinburgh was a garden of forty feet square,—that it has been increased at different periods to 27 acres;—but that, nevertheless, it has not yet attained the dimensions which science and practice alike demand. Nevertheless this is all true.

The origin and progress of the Royal Botanic Garden is a topic of much interest to this Society, and one of much curiosity. It may gratify you, then, that I am allowed to announce, that it is Dr Balfour's intention to give a full account of its history ere long. The little which I have now to say on the subject may serve to convey some idea of what you may expect from the finished inquiry of Dr Balfour, and to correct in the meantime some erroneous impressions which prevail respecting the garden.

There exist documents which clearly show that we owe the first rudiments of a Botanical Garden to the public spirit and influence of two of the most remarkable men in the profession of physic in this country during the last half of the 17th century, *Sir Andrew Balfour* and *Sir Robert Sibbald.* Both of them were much attached to the cultivation of plants, foreign as well as domestic. Sir Andrew Balfour, in particular, had made himself familiar with botany as it stood at that time, through means of the extensive opportunities he had enjoyed for several years during his travels on the Continent, especially in France and Italy. He appears to have been strongly impressed with the idea, that by means of a suitable public garden important medicinal plants might easily be introduced into Scotland and cultivated for medical use, for which medical men were dependent on the uncertain and costly communication which at that time existed between Scotland and foreign countries.

It appears from a manuscript life of Sir Robert Sibbald, in the Library of the Faculty of Advocates, and quoted by Bower in his "History of the University of Edinburgh," that Sibbald and Balfour, with the concurrence of a zealous horticulturist, Murray of Livingstone, hired "an enclosure of

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some forty feet every way," to the north of Holyrood Abbey, from that ubiquitous person, John Brown;—that they put it in charge of a youthful practical gardener, James Sutherland, who afterwards became Professor of Botany;—and that they stocked their little garden-plot with "a collection of eight or nine hundred plants," *multum in parvo* assuredly. This initiative step seems to have been taken in 1670. But the ambition of the botanical triumvirate did not lie long content with John Brown's diminutive patch of ground. They had influence enough to interest in their work the Lords of Session, the Faculty of Advocates, the Town Council, the Earl of Perth, and the Scottish Exchequer; funds were thus supplied from various quarters; and the town granted a lease of the Trinity Hospital Garden, which then became known by the new name of "Physic Garden," the site of which is still marked out by a row of houses of that name facing northwards the North British Railway Station and Calton Hill. Thus was instituted in 1676, for the first time in the correct meaning of the designation, "The Edinburgh Botanic Garden." It is not unworthy of remark, that this undertaking, which has proved of such signal service to our university and city, was at first vehemently opposed by the predecessors of our present College of Surgeons, the "Chirurgeon Apothecaryes." Their objection was a dread that the establishment of such a garden might lead to the creation of a College of Physicians. One does not easily see the connection. But apparently the avowal of the dread led to the realisation of what was dreaded: for in five years more the Royal College of Physicians was erected by royal charter, and mainly through the exertions of Sir Robert Sibbald and Sir Andrew Balfour.

The founders of the Physic Garden were fortunate in their choice of its overseer. A knowledge of botany, however, was not the only accomplishment which attracted Sir Andrew Balfour to James Sutherland. Both of them were collectors of coins and keen numismatologists. But this very different pursuit did not interrupt Sutherland in the zealous discharge of his official duties. So must we infer from the fact, that in a few years he had collected 2000 species of living plants in the garden, and was able

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to publish, when he had been only seven years in office, his "Hortus Medicus Edinburgensis," being a catalogue, with various annexed details, of all the plants cultivated in the garden. Sutherland also taught botany to students. Contemporaneously, indeed, with the conversion of the Trinity Hospital Garden into the Physic Garden under his charge, the Town Council passed a resolution founding a "Profession of Botany" in the University, and appointing him its first occupant. Professor Dalzell, however, in his "History of the University," says Sutherland did not become "properly professor" till 1695. I must leave it to my colleague, Dr Balfour, to discover the cause of this hitch in the history of his chair. Sir Robert Sibbald is silent on the subject, and Dalzell merely states the bald fact. But that the case stood as Dalzell puts it seems highly probable; inasmuch as in 1683, seven years after the date of the Town Council's resolution in Sutherland's favour, he takes in the title page of his catalogue no other official designation than that of "Intendant of the said garden;" he so styled himself likewise in his dedication to Lord Provost Drummond; and in the copyright of his book, granted by the Privy Council of Scotland, he is called "Botanist and Overseer of the Physic Garden," but not professor. It is probable, therefore, that some underhand opposition was long successfully made to his induction into his professorship.

I hope Dr Balfour may be able to disinter some history of Sutherland's garden, which continued to be the Physic Garden of the city and University for eighty-eight years. All I have now to say of it may be comprised in a very few words. It is probable that we might trace the introduction of many foreign plants, now familiarly met with everywhere in Scotland, to the zeal of Sir Andrew Balfour and Sutherland, and to the Physic Garden as their first Scottish habitat. For example, the larch appears in Sutherland's catalogue; and I am not aware that it has been recorded as having been anywhere cultivated by any Scottish proprietor till long after that date. But the species which has principally caught my eye in the catalogue is our common yew,—*Taxus baccata*. Now we know from tradition that there is a yew-tree in the present garden, immediately behind Linnæus's monument, which was transplanted from the last

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Botanic Garden, and which was transplanted thither from the old Physic Garden 112 years ago. But the officials of that day would undoubtedly transplant preferentially their largest or oldest yew; and this would carry back the age of our specimen to at least 193 years, or probably a good many years more; for Sutherland in 1683 would scarcely catalogue a tree merely in its veriest infancy. The conclusion thus come to corresponds with the inference to be drawn from the present girth of the tree and De Candolle's observations on the rate of growth of the yew. Our tree is 5 ft. 6 in. at the ground, and nowhere less than 5 ft 3 in. in girth. De Candolle's rule, of 24 annual layers for every inch of radius, gives about 245 years for its age. It is, so far as I know, the only living representative of the original Physic Garden; and as such I need not say, that this healthy, vigorous patriarch of the present Garden is held in much respect by all who know its great age and the history of its travels.

In the course of time the Physic Garden became on many accounts unsuitable for its purpose: an application was therefore made to Government for removal to a more rural neighbourhood in 1763; the application was favourably received, and in 1764 the Garden was transferred to the head of Leith Walk, where a space of five acres was leased by the Treasury on the property of the Professor of Botany at the time, Dr John Hope. Pennant, in his account of his Tour in Scotland, in 1769, speaks in very favourable terms of the state of the Garden, now become the Royal Botanic Garden, as he saw it only five years after its establishment. To him we are indebted for preserving the information, that the glass houses consisted of a greenhouse of 50 feet, two stove-houses of 28 feet each, and two temperate houses each of 12 feet,—in all 130 feet; and such was the provision when I was a student of botany in 1813. It was a very pretty garden in a really rural locality, situated immediately below Haddington Place. But at the time it was occupied there were no houses nearer it than the first four of Gayfield Place, and none on the opposite side of the Walk at all, only nurseries, parks, and agricultural fields.

Soon after 1813 the students of medicine increased greatly,

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till at length they became nearly 1000. The science of botany was making prodigious strides. The five-acre field, and the little class-room, had become wholly unsuitable. Hence, immediately on the succession of the late Dr Graham to the Chair of Botany, a great effort was made to effect another transference, and the result was the purchase of a part of the present garden from Rochead of Inverleith, and the transference from the old one in 1821 and 1822. It was a slow and laborious process; for no fewer than 1500 trees or shrubs were removed from the one garden to the other over a distance of rather more than a mile; and many of the trees were of great size,—one of them, I think the flowering ash, weighing with its ball of roots and earth no less than nine tons. The transplantation was attended with remarkable success. Only one tree of any importance was lost, and very few were even injured.

The old garden seems to have been struck with a blight in all respects since it ceased to exist as such. Building on that side of Leith Walk stopped with the completion of Haddington Place, at the very western confines of the garden; an attempt to erect a fine crescent on an appropriate site, immediately to the north of it, has proved a failure; and what was garden is now broken up with workshops, and coal stores and hovels, amidst which may still be descried here and there a tree, left behind when Mr Macnab *primus* made his selection for removal,—trees looking much out of place, very miserable, and desirous of death; also Mr Macnab's house in front, very much sunk by the levelling up of the roadway, and in the middle of the space an unaccountable ragged wall, put to no use whatever, which is no less than the back wall of the conservatory. There is no part of the city or neighbourhood which fills me with more disgust and melancholy, when I pass it, than this patch of poverty-stricken ruin and desolation.

But returning to a more agreeable subject,—the new Royal Botanic Garden has been the pet of every one who has had any connection with it,—of its professors and its superintendents, of the University, of the Town Council, of this Society, of many distinguished citizens besides, and of the Crown authorities both here and in London. In consequence, it has only to prove its wants, and its necessities

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are forthwith supplied. Thus its extent has been twice materially added to, until it is now twice its dimensions in 1821. A magnificent palm-house has been erected, and a large temperate house; a museum has been built, and a new class-room with appropriate rooms for practical study; and a fine building has been appropriated to the purposes of a herbarium, which under the auspices of the University has now attained a great magnitude. In every department the garden is in a flourishing condition; even the aged trees themselves seem to rejoice in the surrounding prosperity, and renew their vigour.

Still, however, there is a want; and that is an *Arboretum*. In plainer language, we have no forest. The conversion of the former Experimental Garden of the Horticultural Society into the arboretum of the Botanic Garden has only served to show that the space is insufficient for the purpose. The plantations of exotic trees, some of which, it is reasonable to hope, may be naturalised, are now so dense that in two or three years they must be thinned out. But the plants will by that time be far too valuable to be thrown away in the ordinary mode of thinning a young plantation of common trees, and nevertheless there is no quarter now in the garden to which they can be transplanted. What, however, is of more consequence, there is no fit space for the culture of our ordinary forest trees, for studying the conditions for success in the cultivation of them, the causes of failure, their diseases, and the prevention of them as well as their cure. Consequently there is no opportunity for the study of forestry; and in the present position of the country this appears to be a serious defect. Our Professor turns out no small number of scientific botanists. Our Superintendent sends off annually many first-rate gardeners to all quarters. But there is no acknowledged place in this country where foresters and superintendents of forests can be thoroughly trained; and yet where could this important branch of botanical instruction be so easily taught practically as here, where all the elementary or fundamental training is close at hand, and where we have one thoroughly competent to instruct, and requiring nothing else than a sufficient field for instruction? I have of late been more than once applied to by young men, destined for the charge under Govern-

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ment of the forests in India and our colonies, to recommend them instructors and places for instruction in the management of forests in Scotland, and the request has generally been accompanied with the information that the Government authorities require them to spend a considerable part of their period of study, before appointment, in the forests of France and Germany. I confess that I do not understand this condition. There is no want of extensive forests in England as well as in Scotland. There is no want of experienced foresters. Either our foresters are unwilling or unable to teach. Or pupils are so unprovided with elementary knowledge that they cannot be taught practically. Now that is exactly what they could acquire with ease here, where there is a great botanical school, the greatest in the kingdom. Every other appliance is at hand except a sufficient extent of woodland.

It so happens, however, that this want might be supplied in the immediate neighbourhood. On the west side of the western boundary wall there is a portion of the Inverleith property amounting to 20 acres, which remains as Rochead of Inverleith left it, and which may be had by Government at the present time from the proprietors, the trustees of Fettes College. There is already on it a considerable extent of well-grown wood, consisting of several sorts of forest trees, and there is a fine soil and favourable slope towards the south for the growth of more.

Moreover, this space of ground is of great value to the Botanical Garden on other grounds. In the first place, the wood now on it is of great service as a protection against our storms from west and south-west, which, were this screen removed, might some day devastate the garden. And secondly, the time cannot be very distant when this beautiful slope will come into demand for building; the ground immediately west of it will follow in the same way, and thus a new section of the city will arise, the smoke from which will be carried by the dominant winds over the garden, blackening and eventually withering its trees, and injuring or destroying many shrubs and annuals of exotic origin which are now cultivated with great success. On this latter account I understand that several public-spirited members of the Town Council are disposed to settle the question of

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a West-End Public Park by purchasing the westerly ground, if Government will purchase what is next the garden; so that the Arboretum and park together would form an admirable open space for the recreation of our fellow-citizens of all ranks.

I must also suggest, for the consideration of those whose province it is to grant or refuse the Arboretum, that although the purchase-money will not be inconsiderable, the annual cost of maintenance, after it has been put in order, will be small. One or two foresters will take care of it all; for an Arboretum or specimen forest by no means requires, like the other departments of a botanic garden, that every square foot of ground be carefully and constantly attended to.

I therefore anxiously trust that this important measure will be carried through; and I hope the members of this Society will give the scheme their countenance as a body and also individually their support.

Mr C. S. France, as an old forester, thanked Sir Robert Christison for his able and valuable address, which he hoped would have the effect of stimulating the Government in the formation of an Arboretum in connection with the Royal Botanic Garden, and thus supply a desideratum in the means of instruction for those who are studying arboriculture and forestry. The acquisition of Inverleith grounds would be hailed by all foresters in this country as a most important step in a right direction. The measure would have his warmest support, as well as that of all practical foresters.

The following statement respecting the Members of the Society was read by the Chairman:—

Honorary Fellows:—

Royal Personages,	2
British Subjects,	6
Foreign,	25

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Ordinary Fellows elected during 1873–74:—

W. Caldwell Crawford.
Rev. James Fraser, M.A.
Professor Geikie.
Thomas Hume, M.B. and C.M.
Robert Kirk.
James Leitch.
Professor Lister.
Rev. George M'Arthur, M.A.
J. Sturgeon Mackay, M.A.
John Macmillan, M.A.
Rev. Wm. Murray M'Donald.
C. H. Miller, F.R.S.E.
Rev. James Mitchell, M.A.
David Norrie.
John Patterson.
Dr James Bell Pettigrew.
G. H. Potts.
Thomas B. Sprague, F.R.S.E.
John Stewart, W.S.

Non-resident—Surgeon-Major W. Jameson, Saharunpore.
Associate—Andrew T. Jaffray, Darjeeling.

Deduct deceased,	. . .	13
„ Resigned,	. . .	1
„ Cancelled,	. . .	3

The following are the Obituary notices for the year:—

GEORGE BERRY became a Fellow of the Society in 1858 after the dissolution of the Wernerian Society, of which he was long an active member. He was born in Edinburgh on 12th January 1795, and died on 1st May 1874. He had a successful career as a merchant in Leith, and took an active interest in public affairs. He was fond of mineralogy and geology, and was a zealous supporter of the school of Professor Jameson. He was a Fellow of the Royal Society of Edinburgh.

EDWARD CHARLTON, M.D., D,C.L., was one of the seventeen who originated the Botanical Society of Edinburgh in March 1836, and of whom only six now survive. He was the second son of the late Mr Wm. John Charlton of Hesleyside, Northumberland. This has been the seat of the family from the early part of the 14th century. He was born in 1814, and obtained his early education at St Cuthbert's College, Ushaw, Durham. He afterwards prosecuted medical studies at the University of Edinburgh, and received the degree of M.D. in 1836. His thesis was on the Lead Colic, compared with the Colic of Poitu, West Indies, Madrid, and Devonshire. During his residence at Edinburgh

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he prosecuted natural science with vigour, and devoted special attention to botany. He joined actively in botanical excursions and made a good collection of plants. He took a warm interest in our meetings, and kept up a kindly intercourse with those members with whom he was associated in the early days of the Society's existence.

He afterwards settled as a medical man in Newcastle-on-Tyne, where he attained a high reputation as a physician. At the time of his death he was senior physician of the Newcastle Infirmary. He was President of the Newcastle College, and lectured on medicine. He was also Professor of Medicine in the University of Durham.

He was fond of literary and antiquarian pursuits; and was Vice-president of the Literary and Philosophical Society, of the Natural History Society, and of the Society of Antiquaries of Newcastle. Well versed in Scandinavian lore, he was a member of the Royal Medical Academy of Stockholm and of the Medical Society of Christiania.

He was also an active member of the British Medical Association, and in 1870 acted as President of the Association at the meeting in Newcastle.

He died at Newcastle on 14th May 1874, and his remains were interred at Bellingham, North Tyne.

Dr Joseph Dickson joined the Botanical Society in 1840. He prosecuted his medical studies in Edinburgh, and took the degree of M.D. of his University in 1842. He wrote a thesis "on Crural Phlebitis."

He was fond of botany, and made large collections of plants both in this country and abroad. He contributed largely to the Herbarium of the Society. He was for long settled as a medical man in Jersey.

His death took place at Berwick-on-Tweed on 4th March 1874.

Archibald Douglas, M.D., of 8 Clifton Place, Hyde Park, London, was elected a Non-resident Fellow of the Society in December 1846.

He prosecuted his studies at the University of Edinburgh, was apprenticed to the late Professor Syme, and went

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through his surgical training at Minto House. He became M.D. of the University of Edinburgh in 1838, and wrote a thesis "On the Pathology and Treatment of Dropsy." He afterwards went to London, and about the year 1850 settled there, and entered into partnership with Mr Baker Brown. This arrangement was after a few years brought to a termination, and he commenced practice on his own account. After some time he retired from active practice, but continued to the last to take an interest in his profession, and attended meetings of Medical Societies in London.

His health was for several years delicate. He had an attack of palsy in June 1874, and lost his power of speech. He gradually grew weaker, and after an illness of some days' duration, it terminated in his death at the age of fifty-seven.

ANTOINE-LAURENT APOLLINAIRE FÉE was elected a Foreign Corresponding Member in 1865. He was born at Ardennes, in France, in 1789, and died in 1874, aged 85. M. Fée acted as medical man in the French army during the Peninsular war. When the French empire fell, he became a civilian, and started as a druggist in Paris. In 1819 he founded the Pharmaceutical Society for the Department of the Seine. He afterwards re-entered the army, and did duty in the hospital at Lille. In 1832 he went to Strasbourg, where he became Director of the Botanic Garden and Professor of Natural History to the Faculty of Medicine; he was Honorary Professor of the Faculty of Medicine of Nancy, President of the Société Botanique de France, Officer of the Legion of Honour and of the Order of the Rose of Brazil, and Chevalier of the Order of the Lion of the Netherlands. He is best known by his memoirs on cryptogamic plants and numerous pharmaceutic monographs.

GEORGE RITTER VON FRAUENFELD, keeper of the Royal Museum at Vienna, was a zealous cultivator of natural history, and gave numerous contributions to the Zoologico-Botanical Society of Vienna, as well as to the Academy and Geographical Society of that city. He was

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attached to the expedition of the Austrian frigate "Novara." His observations had relation chiefly to zoology, but he also took an interest in botany. He became a Foreign Member of the Botanical Society in 1865, and a Fellow of the Linnean Society in 1870. He died on the 8th of October 1873, after a short illness. The notice of his death ought to have appeared in the last Transactions.

Dr Robert Edward Grant was born in Edinburgh on 11th November 1793. He received his education in the High School of Edinburgh, and afterwards at the University of Edinburgh. In 1814 he received the degree of Doctor of Medicine. He afterwards travelled on the Continent, and returned to Edinburgh in 1820, where he engaged in practice and became a Fellow of the Royal College of Physicians. He very early showed a taste for comparative anatomy and zoology, and published valuable papers on "The Structure and Economy of Sponges."

He contributed various scientific papers to the "Edinburgh Philosophical Journal" and to the Memoirs of the Wernerian Society. He acted as assistant to Dr Barclay, the famous anatomical teacher in Edinburgh.

In 1827 he was elected Professor of Comparative Anatomy and Zoology in University College, London, and continued to teach for forty-six years without missing a single lecture.

His vacations were occupied in excursions both in this country and abroad, and latterly he paid an annual visit to Edinburgh, residing there for three or four weeks in autumn. He joined the Botanical Society in December 1858. In August 1874 he suffered from an attack of dysentery, and died on the 23d of that month, at his house, close by Euston Square. He was buried in Highgate cemetery. He bequeathed the whole of his property, including his collections and library, to University College.

Archibald Jerdon, of Allerton, was elected a Fellow of the Society in 1871. He was born at Bonjedward on 21st September 1819, and educated at the Edinburgh Academy

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and University. He early showed a taste for natural history, and noted facts connected with the habits of birds, some of which he communicated to the "Zoologist" as early as 1841. He also acquired an extensive knowledge of the phanerogamous local flora, after which he devoted himself to cryptogamic botany, and published lists of the border fungi in the Berwickshire Naturalists' Club Proceedings. Two species of fungi bear his name. Latterly he paid considerable attention to bryology, and was preparing a catalogue of the district mosses for the club at the time of his death, which took place at Allerton, near Jedburgh, in February 1874.

Edwin Lankester, M.D., was born at Melton, near Woodbridge, Suffolk, on the 23d April 1814. He prosecuted his early studies at Woodbridge, afterwards at University College, London, and under Lindley paid much attention to botany. He became a member of the College of Surgeons of London, and in 1839 he visited the Continent, and took his degree of M.D. at Heidelberg. He was elected a Fellow of the Linnean Society in 1840, and in 1843 he lectured on Materia Medica in St George's Hospital. In 1845 he became a Fellow of the Royal Society.

He lectured on Natural History in the New College, London, and in 1856 he became medical officer of health for St James', Westminster. He was also coroner for Central Middlesex.

He was long connected with the Ray Society, and continued to devote his attention to various departments of natural history, especially to botany. He was for many years a popular lecturer in London. He also gave important services to the British Association by acting as secretary to the Natural History department.

He was a great promoter of sanitary and economic science; and published numerous books and papers on microscopic and general zoology and botany. He translated Schleiden's "History of Scientific Botany." He entered the Botanical Society in 1841. An Acanthaceous genus was called *Lankesteria* after him by Dr Lindley. He died at Margate on the 30th of October 1874.

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Carl Friedrich Meissner, Professor of Medicine in the University of Basle, was born at Berne, in Switzerland, on 1st November 1800.

In his early years he was fond of natural history and paid attention to zoology. From the year 1837 botany became his favourite subject of study, and he assisted Lehmann in his description of some of the Natural Orders in his "Plantæ Preissianæ." He described some of the orders in De Candolle's "Prodromus," in Martius' "Flora Brasiliensis," and in Wallich's "Plantæ Asiaticæ Rariores." He also contributed papers to the "Linnæa," "Botanische Zeitung," and to Hooker's "Journal of Botany." He died at Basle on the 2d of May 1874, after a long and painful illness. Dr Meissner was elected a Fellow of the Linnean Society in May 1857, and a Foreign Honorary Member of the Botanical Society of Edinburgh in 1837.

Dr Georg Auguste Pritzel, who was elected a Foreign Member of this Society in 1870, died at Hornheim, near Kiel, on the 14th of June, after a long illness. He was Custos of the library of the Royal Academy of Berlin. He was born at Carolath, in Silesia, on the 2d September 1815. His most important works were the "Thesaurus Literaturæ Botanicæ," the publication of which extended from 1847 to 1851, and his "Iconum Botanicarum Index Locupletissimus," published in 1855, with a supplement in 1865–66. A new edition of his Thesaurus was commenced at Leipzig in 1872; it only extends to four fasciculi, the author having died before its completion. His works are of great value to all working botanists.

Robert James Shuttleworth, the eldest son of James Shuttleworth of Barton Hall, Lancashire, was born at Dawlish, in Devonshire, in February 1810. He married Mademoiselle de Sury, daughter of Count de Sury of Soleure, Switzerland, by whom he had a son and daughter, both of whom he survived. His residence was at Berne until the last few years, when he moved to Hyéres, in France, for the purpose of pursuing his botanical studies. He died there in April 1874. He was one of the earliest

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Fellows of our Society, having been admitted on 14th July 1836. He was a zealous and accomplished botanist, and formed a large and valuable herbarium. He contributed largely to the Herbarium of the Society, and sent communications from time to time in reference to the botany of Switzerland.

Mrs WRIGHT of Halston Hall, Shropshire, was elected a Lady Associate in 1872, and contributed to the Herbarium, and communicated several interesting notices of plants. She died suddenly on 21st May 1874, at the age of fifty-four. She was the eldest daughter of the late Sir David Moncreiffe, Bart.

The following communications were read :—

I. *Notes of an Excursion made by the Scottish Botanical Alpine Club to the Aberdeenshire and Forfarshire Mountains in August* 1874. By Professor BALFOUR.

The Scottish Botanical Alpine Club having in former years visited on several occasions the Breadalbane Mountains and the Grampians in the vicinity of Clova, resolved this year to make an excursion to Braemar, a district in which many rare alpine plants occur, and some portions of which have not been sufficiently examined.

Tuesday, August 4.—The party left Edinburgh for the Spital of Glenshee, and proceeded to Castleton, Braemar, which was reached about 5 P.M., not, however, without some adventurous escapes. As intimation had been given to Mr M'Nab, at the Fife Arms Hotel, of the number of the party and the date of arrival, it was expected that accommodation would have been provided. Unfortunately, however, on their arrival they found the inn full, and all the accommodation available was two attic rooms with two beds in each. In consequence of this, eight of the party were compelled to take up their quarters in a small cottage, one occupying the top of a staircase, one a sofa, one a bed in the kitchen, and one a small couch. In place of the ordinary tea-dinner, the party had to con-

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form to the new arrangements at Braemar, and sit down to a *table-d'hôte* in their ordinary botanical garb amidst an assemblage of visitors in full dinner-dress, with all the appendages of waiters, lacqueys, &c. The old botanical *prestige* of Braemar is now gone, and the custom of putting up plants in drying-paper in the evening is at an end. In fact, botanists are voted a bore, and fashionable excursionists, who pay well, eat, drink, and dress well, are now in vogue. During our visit the plants had to be arranged under very difficult circumstances; when the weather was dry, it was done in the open air. There is no sympathy with what the Prince Consort's keeper called "herb gatherers," an epithet applied by him years ago to a botanist who attempted to ascend Lochnagar.

Wednesday, August 5.—After breakfast the party started for the keeper's house at the foot of Loch Callater, whence they ascended Lochnagar. The weather at first was promising, but ere long it became very wet, misty, stormy, and cold. When they reached the cairn the party were drenched and benumbed. In spite of this some of our number descended one of the steep corries, and succeeded in gathering *Saxifraga rivularis*, and other good alpine plants, such as *Sibbaldia procumbens*, *Gnaphalium supinum*, *Poa alpina*, *Cochlearia officinalis* (alpine variety), *Cerastium alpinum*, *Thalictrum alpinum*. They found it impossible to get down to the little loch at the foot of the cliffs, as a mass of steep rocks completely prevented their doing so. In consequence of the thick mist they had descended the wrong corry, and were therefore compelled to return by a very steep and difficult ascent to the summit, and had thence an uncomfortable descent amidst mist and rain.

Thursday, August 6.—This morning at eight the party started for Canlochan. They proceeded about seven or eight miles on the Glenshee road, where they left the conveyances, and ascended the hills above Canlochan Glen, gathering on the way most of the common alpine plants, such as *Alchemilla alpina*, *Saxifraga stellaris*, *Saxifraga hypnoides*, *Epilobium alpinum*, *alsinifolium*, &c. They also found in considerable quantity *Phleum alpinum*, *Alopecurus alpinus*, and *Polypodium alpestre*. Near the summit of the ridge they gathered *Carex rariflora*, *Carex aquatilis*, and

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Splachnum vasculosum. Descending into Canlochan the party examined the rocks at the upper part of the glen, which are traversed by quartz veins. Among the rarer plants growing among the rocks may be mentioned *Gentiana nivalis* (very large), *Erigeron alpinus*, *Poa alpina*, *Carex capillaris*, *Dryas octopetala*, *Carex atrata*, *Saussurea alpina*, *Veronica saxatilis*, *Saxifraga nivalis*, *Potentilla Salisburgensis*, *Hieracium anglicum*, *H. gracilentum*, *H. chrysanthum*, *Pyrola secunda*, *Antennaria hyperborea*, *Epilobium anagallidifolium.* At 2500 feet were gathered *Prunella vulgaris*, *Arabis hirsuta*, *Lysimachia nemorum*, *Bunium flexuosum*, and *Chrysosplenium alternifolium.*

In the descent into the glen the party passed through an immense profusion of *Allosorus crispus.* They afterwards proceeded to the southern side of the glen, and gathered abundance of *Mulgedium alpinum*, in the old station first discovered by Dr Greville, Mr Brand, and myself in 1837. Ascending the deep ravine which leads up to Glas Maol, we gathered fine specimens of *Saxifraga nivalis*, *Veronica alpina*, *Epilobium alsinifolium*, *Cochlearia officinalis* (alpine form), and *Veronica humifusa.*

From the summit of Glas Maol we had a most extensive view to the sea on the east side. Thence we descended to the Glenshee road, where we met our conveyances at 6 P.M., and returned to Braemar about 7.30 P.M.

Friday, August 7.—This morning the party again started at eight, being divided into two companies; one proceeded by a two-horse drag to the foot of Loch Callater, and thence walked to the rocks at the upper part of the glen, examining especially those around Loch Chander (Kander). Among the plants gathered by the party the following may be enumerated:—*Carex rupestris*, fruiting freely near the Breakneck Waterfall; *Salix lanata*, *Lapponum*, *phylicifolia*, *Myrsinites*, *reticulata*, *herbacea*, and *arbutifolia*; *Carex vaginata*, *stictocarpa*, *vitilis*, *atrata*, *capillaris*, and *rigida*; *Hieracium chrysanthum*, *pallidum*, *microcephalum*, and *eximium*; *Grimmia atrata*, and many other alpine plants. The party did not find *Carex Vahlii*, which was first discovered on the rocks at Loch Chander by Dr Greville and myself; but Mr Sadler was fortunate in finding *Carex frigida*, a new British plant, and a willow new to science,

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which has since been called *Salix Sadleri* by Dr Boswell Syme. In Loch Callater *Subularia aquatica* and *Lobelia Dortmanna* were collected. At the Breakneck Waterfall a fine eagle was seen.

The other division of the party walked to the mountains on the opposite side of the Dee from Castleton, and were accompanied in their walk by the old keeper, Angus Mackintosh, whom I met first at Braemar in 1830. It should be stated that the old guide, John Downie, is still at his post at Braemar, but not able for hill-climbing. He took a great interest in our adventures.

We proceeded to the mountain called Little Craig-in-dal, where we gathered abundance of *Astragalus alpinus* in the station first discovered by me in 1847. In many parts of the hills this plant forms the turf, and is said to be eaten by the deer. A considerable number of the plants were in flower. Among other plants observed I may mention *Betula nana*, *Cornus suecica*, and of alpine Hieracia, *Hieracium eximium*, *H. pallidum* var., *H. melanocephalum*.

Dr Craig and Mr Gibson visited the summit of Ben Avon, but did not get any additional plants of interest. They met with a small one-flowered form of *Gentiana campestris*. They were unable to reach the spot where *Saxifraga cæspitosa* was gathered many years ago by Dr Martin Barry.

The day was sunny, with occasional showers, and the views of Lochnagar, Cairn Toul, Ben Macdhui, and other high mountains were very fine. The two divisions of the party met again at the hotel at 7 P.M.

Saturday, August 8.—The party left Braemar after breakfast, in two drags and a dog-cart, for the Spittal of Glenshee, where they changed horses and conveyances, and proceeded to Blairgowrie amidst heavy showers. They reached the railway station in time for the train at 2.50 P.M., and arrived in Edinburgh at 6.30, to witness the end of a terrific thunderstorm.

The number of miles travelled by the party was about 350, and the total necessary expenses about L.5 each.

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II. *Notice of a new Alpine Willow* (Salix Sadleri *of Syme*), *recently discovered in the Highlands of Scotland. By* JOHN SADLER, Sec. Scot. Alpine Bot. Club. (Plate I.)

While taking part in an excursion of the Scottish Alpine Botanical Club on 7th August 1874, I was fortunate enough to discover a small alpine shrubby willow hitherto unknown to science. The locality where I met with it was high up on the precipitous rocky turfy ledges to the east of Loch Chander, or properly Loch Ceann-Mór, the loch of the big head, near the head of Glen Callater, in Aberdeenshire. The altitude at which it was growing was, according to the Geological Survey Map, about 830 yards above the sea, and the surrounding scenery is of the wildest and most desolate description. I observed only two plants, both of which were female, and fruiting freely. The roots were left undisturbed, so that others may rediscover the habitat.

Specimens were submitted to Dr Boswell Syme, who kindly drew up the following characters for the species, and did me the honour of naming it after me:—

"SALIX SADLERI (*Syme*) *Sadler's Alpine Willow.*

"*Stems* mostly buried, rooting; *branches* very short ascending, apparently terminating in a peduncle. *Leaves* few, very shortly stalked, firm, roundish-ovate, rounded or subcordate at the base, acute or sub-acute, entire, dark-green, and more or less cottony but not rugose above (the veins not being impressed), ultimately glabrous and green beneath, with the midrib, secondary, and the tertiary veins prominent beneath, but the greater number of the ultimate veins conspicuous but not prominent, the interstices sprinkled with minute white dots; *stipules* absent, but *scales* sometimes persistent. *Catkins* opening after the leaf-buds, on rather short leafless peduncles, apparently terminating the branches, slender, oblong-cylindrical, short, many-flowered; *catkin-scales* oblong-oblanceolate or oblong, or narrowly oblong, obtuse or sub-obtuse, at length dark brown, tipped with black, with a few woolly hairs on the back, and a dense coma of white silky-woolly hairs at the apex and

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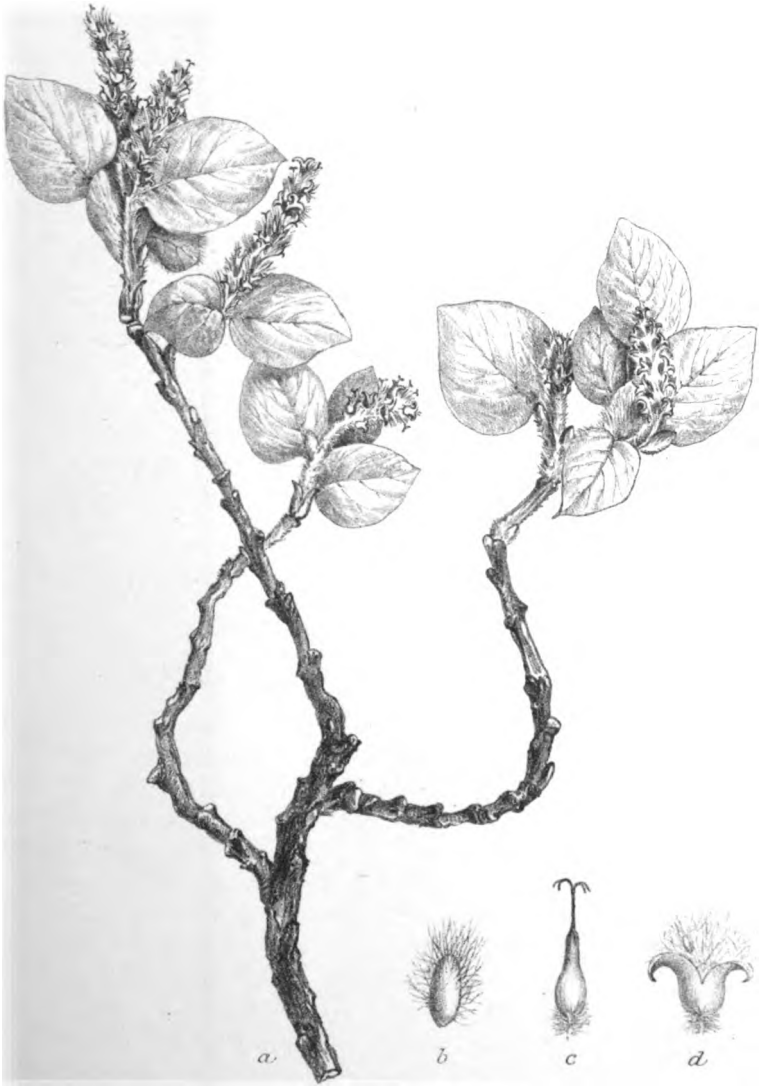

SALIX SADLERI (Syme)

F. M. Caird, del.t 1874

M.t Farlane & Erskine, Lith.rs Edin.r

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F. M. Caird. del. 1874.

M.r Farlane & Erskine Lith.r

CAREX FRIGIDA (Allioni)

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extending beyond it nearly the length of the scale. *Capsule* lanceolate-conical, acuminate, glabrous, with a long woolly stalk; *style* half as long as the capsule, exceeding the stigmas; *stigmas* linear, two-cleft. *Young branches* woolly; *young leaves* thickly clothed with long silky woolly hairs, beneath which are sub-persistent on the midrib; *buds* finely pubescent, ultimately glabrous.

"Stems very similar to those of *Salix herbacea.* Branches blackish chestnut, tortuous, with short leafy branches at the end of the previous year's wood, each branch with two to three leaves. Leaves ½ to 1 inch long, exclusive of the petiole, which is about ⅛ inch long. Peduncles about ¼ to ⅜ inch long, woolly. Catkins produced as in *Salix reticulata*, ½ to ¾ inch long, with the scales much shorter than the capsules, but the tips of their hairs reaching nearly to their apex. Capsule about ⅛ inch long, on a stalk about $\frac{1}{10}$ inch long. Style $\frac{1}{10}$ to ⅛ inch long.

"Similar in habit to *Salix reticulata*, but the leaves differing in shape and in texture; the under side especially is strikingly different, not being hoary, and with no prominent network of veins beneath. The stalk of the catkin is shorter and more woolly. The scales are very much narrower, resembling in shape and vestiture those of *Salix Lapponum.* The capsules, which are mostly opened in Mr Sadler's specimens, are glabrous, whatever they may have been in the young state. The style and stigma resemble those of *Salix Lapponum* more than those of *Salix reticulata.*"

Explanation of Plate I.

Fig. *a*, plant *nat. size*, drawn by F. M. Caird from nature; *b*, scale taken from about the middle of catkin (scales near the top of the catkin are narrower); *c*, pistil; *d*, open capsule. *b*, *c*, and *d* are slightly magnified.

III. *Notice of* Carex frigida, *Allioni, recently discovered in the Highlands of Scotland.* By John Sadler. (Plate II.)

I discovered this interesting Carex, which is a plant of the Alps of Central Europe, growing on wet turfy ground between rocky ledges above Loch Ceann-Mór, Glen Callater, Aberdeenshire, on 7th August 1874. The altitude at which it was growing was about 900 yards above the sea.

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In one place it grew in considerable quantity, covering several yards of surface, and was very conspicuous from its rich green foliage and its dark fruiting spikes. The spot where it occurs is very difficult to reach, owing to the precipitous nature of the ground. Besides herbarium specimens, I secured living plants, which are growing freely at the Royal Botanic Garden, Edinburgh.

Dr Boswell Syme has drawn up the following description of the species taken from my specimens:—

"C. FRIGIDA, *Allion. Fl. Ped. II., p.* 270; *Dec. Fl. Franc. III., p.* 124; *Gaud. Fl. Helv. VI., p.* 121; *Host. Gram. Austr. IV. tab.* 90; *Reich. Ic. cent. XVIII. fig.* 616.

"*Rootstock* shortly creeping and stoloniferous. *Stem* erect, rather slender, triquetrous, rough on the edges from immediately below the first bract to the apex, leafy near the base, and usually with one leaf about the middle. *Leaves* shorter than the stem, firm, linear, flat, rough on the margins, green, not glaucous. *Male spike* one, fusiform, without female flowers at the apex, shortly-stalked, much exceeding the female spikes; *female spikes* three or four, the upper approximate and subsessile or shortly stalked, the lowest one rather distant, and on a long exserted stalk, drooping or pendulous, oblong-cylindrical, rather lax, several or many flowered. *Bracts* sheathing foliaceous, the lowest one with a lamina much exceeding the stalk of its spike. *Glumes* of the female flowers oblong, acute or mucronate, madder-purple, with a pale greenish midrib, and sometimes very narrow pale margins, much shorter than, but as broad as the fruit. *Fruit* ascending, sessile, lanceolate-fusiform, trigonous, not inflated, scarcely ribbed, quite smooth, shining, purplish-black, bordered with green, and often with a pale patch on the back towards the base, very gradually acuminated into a long straight rough-edged bifid beak, nearly half as long as the rest of the fruit; teeth of the beak not with a white and scarious edge on the inner side; *stigmas* three; '*nut* brown, longly stipulate, elliptical-trigonous, punctate.'

"Stems of Mr Sadler's specimens 6 to 9 inches high. Leaves 2 to 6 inches long, by $\frac{1}{8}$ to $\frac{1}{4}$ inch broad, sheathing

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the base of the stem, and one in the middle; the lowest sheaths without any lamina. Male spike about ½ inch long, fusiform, female spike ¼ to ½ inch long. Fruit about ⅛ inch long. The male spikes in Mr Sadler's specimens have one or two female flowers towards the base.

"The leaves resemble those of *Carex binervis*, but the spikes and fruit are quite unlike those of any other British Carex, though similar to those of *Carex fuliginosa*, which differs by its cæspitose growth, narrower leaves, white margined internal edges of teeth of the fruit and clavate male spike, with female flowers at the apex."

10*th December* 1874.—ALEXANDER BUCHAN, M.A., in the Chair.

The following Communications were read:—

I. *Botanical Trip to Mont Cenis and the Maritime Alps.* By GEORGE MAW, F.G.S., F.L.S.

Mr Ball, in his "Guide to the Western Alps," says of Mont Cenis that "it is one of the best headquarters for a naturalist in the entire chain of the Alps." There is no part of the Alps more easily accessible. You may breakfast in London, and on the evening of the following day find yourself comfortably quartered on the summit of the Pass, between 6000 and 7000 feet above the sea, almost within sight of the glowing plain of Lombardy, and surrounded by mountains abounding in the richest gems of the alpine flora.

Soon after daybreak, just twenty-four hours from leaving London, you are entering a picturesque valley through the chain of the Jura, shut in by noble escarpments of oolitic limestone, clothed with a luxuriant growth of Box and a rich subalpine flora. Many interesting plants are seen from the railway, including *Orchis laxiflora*, *Centranthus angustifolius*, with pale rose-coloured flowers. Here and there, at the margins of the woods, *Spiræa Aruncus* displays its feathery sprays of elegant cream-coloured flowers, and in the early autumn *Sambucus racemosa* is conspicuous with its bunches of coral-red fruit. One of the commonest plants

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by the side of the railway and on the shingle beds of the stream is *Epilobium rosmarinifolium*—perhaps the most ornamental species of the beautiful genus. It attains a height of 3 feet, and in the higher alps assumes a dwarfer habit, under the name of *Epilobium Dodonæi*.

Salvia pratensis is a frequent weed on the railway banks, and here and there may be seen *Salvia Sclarea* and *S. glutinosa*. Amongst the other commoner plants may be enumerated *Saxifraga rotundifolia*, *Sedum altissimum*, *Primula farinosa*, *Saponaria ocymoides* (which forms lovely rose-coloured patches on the rocks), *Genista sagittalis*, *Teucrium Chamædrys*, and *T. montanum*.

At 9 A.M. Culoz Junction is reached, and after half an hour's delay for the division of the Swiss from the Italian train, we turn south, cross the Rhone, skirt the beautiful lake of Bourget, and enter, after passing Chambéry, the Val de Marienne. The line gradually ascends through a picturesque subalpine district. *Hippophae rhamnoides*, laden with orange-scarlet berries, is remarkably abundant on the shingle beds of the valley, and *Berberis vulgaris*, in full fruit, is one of the commonest shrubs. Here and there the remains of ancient moraines form dams across the ravine, through which the turbid river has cut narrow channels, and rushes amid huge boulders in its course towards the Isère. Deeply striated rock surfaces are occasionally seen where the glacial *débris* has been removed, indicating the former existence of a great glacier that filled up the valley, and has now receded 20 miles in distance, and 4000 or 5000 feet in altitude. The valley gradually narrows, and up the lateral ravines glimpses are occasionally obtained of the snow-capped summits of the Mount Tabor range to the south, and the Dent Parassée to the north. Picturesque cliffs of contorted strata of the age of our lias and upper trias shut in the valley through which the rail ascends, and here and there are so twisted as to completely invert by great folds the succession of the beds. Soon after one o'clock Modane is reached, and the entrance of the great tunnel high overhead approached by a double bend in the railway, and a steep incline of three miles. Mont Cenis is, however, still fifteen miles off, and leaving the rail at Modane, a drive of three or four hours brings me at nightfall to the

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village of Lans le Bourg. Here at a height of 4465 feet I am at the foot of the Pass, and on the following morning, after an early breakfast, climb up the steep northern slope of 2000 feet, a long straight incline of alpine pasture, enlivened by the bright blue flowers of *Gentiana ciliata*, and I reach the summit of the Pass at nine o'clock. I know of no point in the Alps more beautiful than this; northwards I look down between 2000 and 3000 feet into the deep ditch-like valley of the Maurienne, and on to the very roofs of Lans le Bourg, overhung on the opposite side by the snow-capped summits of the Dent Parassée, and the Grand Casse between 12,000 and 13,000 feet high, and 7000 feet above where I stand, the view to the right being completed by the wild valley of Bonneval.

The Pass of Mont Cenis is an irregular plateau 6 miles across, with an average altitude of between 6000 and 7000 feet, and bounded on the right and left by mountains exceeding it in height by 3000 or 4000 feet. The *tout ensemble* is charming. Soon after reaching the top of the Pass, I look down on a pretty blue lake occupying the middle of the plateau, and on a terrace of crystalline white sulphate of lime. Overhanging it is an inn, which affords tolerable quarters. The brilliant alpine flora has passed its prime, but the scene is full of attractions, both of form and colour. The marshy meadows surrounding the lake are of a rich golden brown seared by "the mellowing year," and bright with patches of *Saxifraga aizoides*, and a band of fresh emerald-green vegetation separates this from the blue waters of the lake. The foreground is very singular; the terrace of several hundred acres of white saccharoid limestone overhanging the lake has been perforated with thousands of "pot-holes," due to the gradual dissolution of the limestone by watery percolation. Some of these are 30 feet deep, and they are in such close juxtaposition that the whole terrace has been wrought into an intricate network of narrow ridges environing deep pits, forming a complete honey-combed surface, across which it is difficult to climb without making a long and sinuous *détour*.

On the opposite side of the lake the brown mountains shut in the view, the Petit Mont Cenis to the right, and Mont d'Ambin to the left, their picturesque outlines deve-

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loped by a fresh sprinkling of autumnal snow, and framing in the more distant ranges over the Gorge of Savalain.

A complete list of the plants of Mont Cenis would include a large proportion of the alpine flora, but the following (including some species at the base of the mountain) were amongst my gatherings.

The plateau of Mont Cenis at the time of my last visit in September was bespangled with the beautiful blue flowers of *Gentiana ciliata* and the miniature *Colchicum alpinum; Primula farinosa* covers the moist meadows surrounding the lake, and amongst the more general plants on the plateau level may be enumerated—*Gentiana excisa, G. asclepiadea, G. verna, Hugueninia tanacetifolia, Atragene alpina, Centaurea uniflora, Gnaphalium Leontopodium, Alyssum alpestre*, and another species of *Alyssum, Erysimum helveticum* (on the limestone terrace above the lake), *Draba aizoides, Tunica Saxifraga, Aster alpinus*, several species of *Sempervivum, Dryas octopetala, Herniaria incana, Teucrium montanum, Ononis rotundifolia, O. Natria*, with golden-yellow flowers, a most striking plant, but not easy of cultivation; *Gypsophila repens, Polygala Chamæbuxus, Bellidiastrum Michelii, Campanula pusilla, C. rhomboidalis, C. thyrsoidea, C. barbata, Silene acaulis, S. exscapa, Saponaria ocymoides, Anemone vernalis, A. alpina, Viola biflora, Viola calcarata* (varying with blue, yellow, and buff flowers), *Lilium Martagon, Bupleurum ranunculoides, Rhododendron ferrugineum, Aquilegia alpina, Thalictrum aquilegifolium, Convallaria verticillata, C. Polygonatum*, and a host of other alpine plants. In Saxifrages Mont Cenis is particularly rich. During a former visit I, in company with my friend Mr J. Westcombe, met with sixteen species during a short afternoon's walk; one of the most abundant is the lovely little *Saxifraga cæsia*, which adorns with its neat little cushions of silvery leaves and white flowers the tufaceous rocks on the west side of the lake; and in company with it we found the rarer *Saxifraga valdensis*, easily distinguishable to the touch by its hard crusty masses of rosettes. This species is limited to a small district in the Western Alps.

Saxifraga diapensoides, allied closely to *Saxifraga valdensis*, and also to *Saxifraga Tombiena* of the Eastern Alps, is said to grow on the meadows surrounding the lake, but

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I failed to find it after a diligent search. Scattered over the mountains on either side of the lake we found *Saxifraga aizoides*, *S. Aizoon*, *S. androsacea*, *S. Sequieri*, and *S. aspera*, *S. exarata*, *S. hypnoides*, *S. oppositifolia*, *S. retusa*, *S. petræa*, *S. planifolia*, *S. rotundifolia*, and *S. stellaris* were also observed. The rare and curious *Saxifraga biflora*, with both white and vinous-red flowers, I found in great abundance on the loose *débris* receiving the drainage of a small glacier, on the mountains to the east of the lake. This species, I believe, never occurs except in the immediate neighbourhood of melting snow, which will, perhaps account for the extreme difficulty of keeping it alive under cultivation. Associated with this fleshy-leaved species are several unallied plants with similar fleshy leaves, including *Ranunculus glacialis*, *Thlaspi alpestre*, and the lovely little *Campanula cenisia;* these afford an instance of the frequent occurrence in geographical association of plants wholly unallied possessing some common secondary character, either in the colour of their flowers or character of foliage or appendages. Another charming little plant, abundantly distributed over the Mont Cenis range, is *Petrocallis pyrenaica*, a draboid plant, with delicate rosy lilac flowers springing out of mossy tufts of bright green foliage, resembling *Saxifraga hypnoides* in miniature. On the mountains to the west of the lake the rare and beautiful *Primula pedemontana* grows abundantly; in habit it resembles a miniature Auricula, with large vivid rosy flowers with a white eye. I find this is one of the easiest species to cultivate, and a very free bloomer. The geographical range of this species seems very limited, as it is nowhere found in the Swiss Alps, and does not extend southwards to the Maritime Alps.

Dianthus neglectus is another lovely alpine, abundantly distributed throughout the Mont Cenis and Dauphiné mountains. In the end of June nothing can be more lovely than large patches of this pigmy pink, covered with its beautiful crimson flowers. Another more local plant occurring on the mountains west of the lake is *Saponaria lutea*, forming compact cushions of linear leaves, and bearing neat little heads of dull yellow flowers three or four inches high. Scattered about the mountains overhanging the Col du Clapier, at an altitude of from 8000 to 10,000

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feet, *Eritrichium nanum* occurs on the drier ground, and is conspicuous by its bright patches of densely blue flowers, contrasting beautifully with the gem-like cushions of the rosy *Androsace glacialis*, with which it is intermixed. Here also occur *Lychnis alpina*, and silvery white patches of *Artemisia glacialis*, *A. mutellina*, and *Senecio incanus*; also *Veronica alpina*, *V. fruticulosa*, *V. Allionii*, *V. bellidioides*, *V. tenella*, *Sedum atratum*, *Gentiana nivalis*, *G. brachyphylla*, *Astragalus aristatus*, *Alchemilla pentaphylla*, *A. subsericea*, *Astrantia minor*, *Silene rupestris*, *Alsine verna*, *A. ciliata*, *Allium sphærocephalum*, *Potentilla pedemontana*, *Arnica montana*, several Phyteumas, *Adenostyles albifrons*, *Achillea moschata* and *A. nana*, *Androsace carnea*, *A. lactea*, *Aretia Vitaliana*, *Myosotis alpestris*, *Erysimum pumilum*, *Oxytropis fœtida*, *O. pilosa*, and several species of Astragali. This last might be much amended, but as my fortnight's ramble included a visit to the Maritime Alps, to which I must make some reference, I will bid adieu to Mont Cenis.

After four days' stay on the plateau, I crossed the Italian side of the Pass to Susa, by a continuous winding descent of about 4000 feet round the spurs of the Mont Cenis range into the valley of Susa, a hot *cul-de-sac*, which, before the opening of the tunnel, was the great highway between France and Italy. I leave the alpine flora behind me, and soon find myself again on the railway between mulberry orchards, vineyards, and fields of ripening maize, and enter, just before reaching Turin, on the great north Italian plain, which affords evidence of having been submerged during glacial and post-pliocene times.

Looking from Turin to the west, the alpine range of Savoy is seen to make a bend to the south-west, returning in an easterly direction along the Mediterranean coast, and environing a great bay of the plain of Northern Italy, which runs up as a dead level to the very foot of the mountain chain. I crossed this in about three hours by the line from Turin to Cuneo, a picturesque city at the foot of the northern flank of the Maritime Alps. The grand mass of Monte Viso, 12,643 feet high, is seen to the north-west, from which the main chain branches out to the south in picturesque outline to a height of from 9000 to nearly 11,000 feet, for the most part a single ridge, with

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lateral spurs enclosing narrow valleys. A drive of two hours takes me to Valdieré and the village of Entraque, situated in one of the lateral valleys on the north side of the watershed, which I made my headquarters for four days. There is, perhaps, no part of the Alps so little frequented by tourists, though so rich in beautiful scenery and natural productions. It must be confessed that the accommodation is, for the most part, wretchedly poor, but fair quarters can be obtained from June to the end of August at the Baths of Valdieré, situated at the head of one of the principal valleys. There is also a tolerable inn at Limone; both places are capital centres for a naturalist. The change in the flora from that of Mont Cenis is very striking. Quite one-fourth of the species are new to me, and many of these are peculiar to the Maritime Alps. Soon after leaving Cuneo the following species presented themselves:—*Anchusa Barrilieri*, a lovely little plant with intensely blue Forget-me-not-like flowers, the handsomest of the genus. *Lamium longiflorum*, *Satureia montana*, *Alyssum halimifolium*, on limestone rocks between Bourg St Dalmazzo and Valdieré, which are also covered with the beautiful *Saxifraga lantoscana*. In May and June this forms a conspicuous feature in the flora of the Maritime Alps, decorating many of the rocks and cliffs with its feathery panicles of snow-white flowers. *Aster Acmellus* is abundant on the rocks between Vernante and Limone. *Dentaria digitata* and *D. pinnata* are conspicuous and beautiful, with their graceful foliage and handsome pink and white flowers. Another striking plant is *Streptopus distortus* (or *Uvularia amplexifolia*), allied to Convallaria, which I found in the Valle dell' Anmellina, near Limone. Of Primulas there are several species, distinct from those found on the Mont Cenis range, of which *Primula marginata* is the most conspicuous. In many places the rocks are completely covered with the handsome rosettes of its silver-fringed leaves. *Primula viscosa*, All. (*P. latifolia*, Lap.), *P. suaveolens* and *P. farinosa*, are also abundant; but *P. pedemontana*, so common on Mont Cenis, is not to be found in this region.

The alpine meadows in June are richly enamelled with the white and red forms of *Orchis sambucina* intermixed

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with *Corydalis cava*, both white and rose colour; and in the Valle dell' Anmellina near Limone, associated with hundreds of the lovely yellow Fritillary (*Fritillaria delphinensis*, *Moggridgei*), bulbous plants are extremely abundant. I found *Tulipa australis*, a small brown Fritillary (*Fritillaria delphinensis*, *Burnati*), *Muscari botryoides*, *Leucojum vernum*, several Gageas, one or two species of Allium, and both the white and violet varieties of *Crocus vernus* intermixed with *Soldanella alpina*. *Cardamine asarifolia* is abundant by the banks of the water-courses, and higher up in the Valdieré mountains I found the rare *Senecio Balbisianus*, also *Achillea Herba-rota*, *Asplenium alternifolium*, *Silene cordifolia*, *Anemone ranunculoides*, *Leucanthemum coronopifolium*, and several other alpine Composites. Amongst the specialties of the ridge of the Maritime Alps, *Viola nummulariifolia* is one of the most beautiful, and grows abundantly at an altitude of 8000 feet, near the Colle de Cerise and Colle de Fenestrelle. In habit it resembles *Viola biflora* in miniature, but with bright azure-blue flowers and round leaves. The local *Saxifraga pedemontana* makes vigorous tufts of bright green rosettes in the midst of a great mass of dead leaves, the remnant of many years' growth. It is only found near the snow line, and is difficult to cultivate. But by far the most interesting plant of this region is *Saxifraga florulenta*, confined to a limited area of the Maritime Alps, and known in no other part of the world. It is said to have been discovered in the year 1824 by an English tourist, who communicated specimens to Professor Moretti, of Pavia. He published a short description of the plant at the time, after which it was vainly sought for by many botanists, till M. Lisa rediscovered it in the year 1856 near the Colle de Fenestre. Fresh localities have since from time to time been discovered in the same region, where, at an altitude of from 7500 to 9000 feet, it seems to be far from unfrequent; but all the habitats are within a radius of 4 or 5 miles of the spot where it was originally discovered.

During my recent visit I had the good fortune to observe it in two unrecorded habitats—viz., on rocks with a northern exposure near the Colle de Fenestrelle and the Colle de

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Cerise, where its glossy green symmetrical rosettes, some of them 6 inches in diameter, nestle under the projecting ridges. Out of many hundred plants I found but one in flower, from which the excellent figure, from a drawing by Mr Fitch, in the "Botanical Magazine" for July, was taken. The rosettes evidently attain a great age before flowering, and then die, falling into the snow-fields at the foot of the cliffs, where, judging from the number I found, they must remain undecayed for many years. The flowers are of a dull rose colour, and are produced at a dense thyrsus on a glandulose stem from 15 to 18 inches in height. Its nearest ally is *Saxifraga mutata*, but as it is so unlike any other species, and has three instead of two styles and carpels, it is open to question whether it should not be placed in a separate genus.

After several days' exploration of the many beautiful valleys intersecting the northern side of the watershed of the Maritime Alps, I again descended from Entraque, and following the main road from Cuneo to Nice, crossed the Colle de Tenda at a height of 6158 feet. From this point a magnificent view is obtained. To the north I look down on the great western bay of the north Italian plain, bounded by the Alps, the complete range of which, from Monte Viso to Monte Riso, is visible in the distance, framed in by the northern spurs of the range on which I stand. To the west, the fine chain of mountains forming its watershed rise in picturesque succession ; and to the south I look over a confused mass of peaks, and catch a single glimpse of the Mediterranean some 18 miles off, the foreground being a long straight descent of 3000 feet to the valley of the Roja, down which the road winds by numerous short bends and zig-zags to a narrow gorge, shut in by precipitous limestone cliffs. *Fritillaria delphinensis*, *Tulipa australis*, and many other subalpine species enamelled the meadowy slope in early June. *Genista cinerea* is also abundant, and this is one of the habitats of the rare *Cytisus Ardoina*. Many other leguminous shrubs festoon the limestone rocks bounding the valley at the foot of the Pass, in company with *Saxifraga lantoscana*, *Micromeria Piperella*, *Alyssum halimifolium*, and other species. At about 4 miles from the foot of the Pass the road suddenly turns to the right,

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and I approach the picturesque town of Tenda, situated at a height of 2680 feet in a hot valley bounded by limestone cliffs. Here many fresh species present themselves, including *Silene cordifolia*, *Mœhringia papulosa*, *Fritillaria involucrata*, *Saxifraga cuneifolia*, *Asperula hexaphylla*, *Passerina dioica*, *Euphorbia spinosa*, *Saxifraga cochlearis*, &c., associated with a few alpine plants, such as *Saxifraga valdenis* and *Sempervivum arachnoideum*, which are rarely found at so low a level.

The road from Tenda towards Nice rapidly descends the valley of the Roja, which for 7 or 8 miles is contracted to a narrow defile, resembling the Via Mala on the Upper Rhine, but on a grander scale and more beautiful aspect, the river and road being narrowly pent in between high cliffs, here and there interrupted by lateral ravines, up which glimpses of the mountain ranges are occasionally seen. Many fresh species present themselves, including *Primula Allionii*, *Potentilla saxifraga*, *Mœhringia dasyphylla*, and the abundance of the individuals of those special to the district give a marked character to the flora.

The cliff sides are festooned with silvery patches of *Cineraria maritima*, and a rich arboreal vegetation, contrasting with the alpine district we have just left, adds to the beauty of the scene. Passing views of the valleys of the Miniera on the right and Briga on the left are especially lovely. We descend rapidly through chestnut and olive groves, alternating with narrow gorges, through which the Roja foams in boiling rapids and cataracts, the rocks on either hand being clothed with noble patches of *Centranthus ruber*, *Campanula macrorhiza*, orange lilies, *Cineraria maritima*, *Saxifraga lantoscana*, and other species.

The frontier town of Fontan was reached at nightfall, from which, on the following day, I made an excursion up the Val de Caiross, leading over by the Col de Rans to the valley of Lantosca, one of the habitats of the true *Lilium pomponium*. *Saxifraga lantoscana*, *S. cochlearis*, and *Potentilla Saxifraga* adorn the rocks; and here I also found *Primula Allionii*, *Mœhringia dasyphylla*, *Sedum alsinifolium*, *Micromeria Piperella*, &c. From Fontan the road passes through another defile, the Gorge of Saorgio, shut in by precipitous cliffs, and terminating at Breglio, where we

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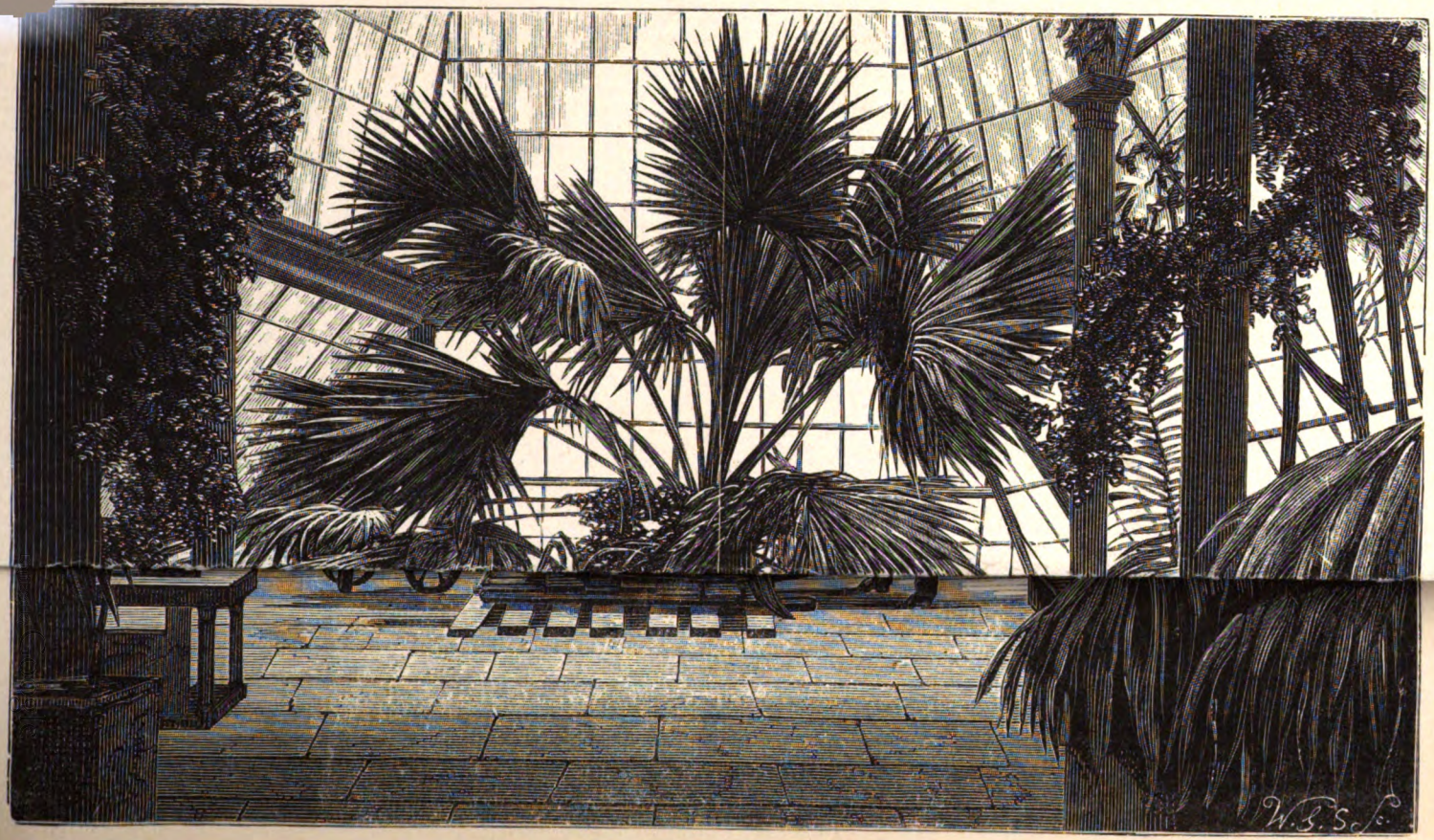

SABAL UMBRACULIFERA IN THE PALM STOVE AT EDINBURGH.

leave the valley of the Roja, which turns to the south towards the coast of Ventimiglia. The road winds over two of the lateral spurs of the Maritime Alps, and reaches Nice through a hot valley rich with fig trees, pomegranates, vineyards, olive groves, and patches of *Arundo Donax*, 18 feet high, the result of little more than seven months' growth. The herbaceous and bulbous plants have long passed their beauty, but the aspect of the district in September is much more fresh and green than I had anticipated, from the abundance of deciduous and evergreen trees now in full leafy strength. At Nice the market held daily in the streets strikingly exhibited the richness of the district in the extraordinary quantity and variety of fruit—figs, pomegranates, tomatos, grapes, peaches, capsicums, prickly pears, &c., exposed for sale under the shade of the plane-tree avenues. I have now wandered far away from Mont Cenis and the Maritime Alps, which have been the subject of my paper, and a passing glimpse of the beautiful Mediterranean coast on my homeward route, with its shrubby headlands and blue bays, rich in a flora peculiar to itself, concludes a fortnight's pleasant ramble.

II. *Notice of* Sabal umbraculifera *in the Palm Stove at Royal Botanic Garden, Edinburgh.* By JAMES M'NAB, Curator. (Plate III.)

An addition has recently been made to the conservatories in the Royal Botanic Garden at Edinburgh, by fitting up in the open space in the centre of the chief range, a temperate house for the growth of cool Palms and tall hard-wooded exotic trees. The extra accommodation thus secured for these plants has permitted the removal of the temporary partition, which for many years separated the eastern octagonal portion (previously used for the cool Palms, &c.) from the present large Palm-house,—thus converting the two houses into one for the growth of tropical Palms, &c.

In the centre of the large Palm-house, and immediately opposite the chief entrance door, stood a fine specimen of the Bull Palm (*Sabal umbraculifera*). It was in a tub, 22 feet in circumference and 4 feet 9 inches in depth. It had

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stood in this position for nearly seventeen years, and during that time had made great progress. The lower part of the tub was completely decayed, in consequence of the heat and moisture; and although it was originally raised on bricks three inches from the floor, the bottom had given way, and the whole under-space had become a dense mass of matted roots, resting on the surface of the stone floor. Owing to the decayed condition of the tub, the removal of this tree, in an upright position, became a matter of serious consideration. In the end of October and the early part of November preparations were made for its removal. Two strong planks, 8 feet long and 10 inches broad, were first introduced below it, one at each side; and, by means of strong lever power along the sides of these two outer planks, two strong 8 feet long battens were put further under, alternately on each side, till they nearly reached the centre. This done, the ends of each, beginning with the west side, were raised to such a height as to allow a strong cross plank to be inserted to receive all the ends of the longitudinal ones; the same was also done on the east side. Lever power was then applied under the cross plank, which enabled longitudinal supports, 10 inches long, to be put in, one under each end, but within the line of the cross plank, in two uniform thicknesses, till the mass was raised 5 inches above the floor. The east side of the plant was raised in the same manner six inches. Similar supports were also put under the broad side planks, at regular distances, three on each side. When the plant was resting on the eighteen 5-inch high supports, the cross planks were removed, and long smooth boards, used for flooring purposes, were then pushed under the plant from east to west, and between the temporary 5-inch high supports. Iron rollers, 6 feet 8 inches long, and 3 inches in diameter, were introduced under the planks and battens, but above the flooring boards, from north to south; all the supports were then removed, and the mass rested on the iron rollers. By means of block and tackle, the plant was drawn, over a series of flooring-boards, to its new situation in the centre of the octagon-house.

The distance was 44 feet, so that the Palm now stands exactly 80 feet from the chief entrance door, from which

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it presents a very noble appearance, there being a broad, open space between it and the door. After removal, by means of the leverage power, the supports were again put under the ends of each of the planks and battens, to such a height as enabled all the iron rollers to be taken out. Numerous porous bricks were then driven below every portion of it, between the battens and flooring-boards, to act as a means of drainage; the old iron hoops and staves of the tub were next removed, when the surface of the ball was found to be covered with a dense mass of matted roots, which had enabled it to stand the strain it had undergone. A box was then erected round it, 7 feet 10 inches square and 5 feet deep, made of well-seasoned red-wood plank, 2½ inches thick, the sides being kept together by iron rods and screw bolts, placed along the two opposite sides. After sufficient drainage materials had been put in, the whole box was filled up with old turfy loam, and well watered.

The Sabal stands 36 feet high from the surface of the floor. It has a clean upright stem, 14 feet in height. The circumference at the base is 5 feet 4 inches, and 3 feet at the top, where the leaves begin. At present the leaves are forty in number. The side ones, including the leaf-stalk, are about 16 feet long, the leaf-stalk being 10 feet and the frond 6 feet long by 5 feet 6 inches broad. The head of the Palm is somewhat globular, and is 22 feet in diameter. All the leaves and stalks are naturally curved, otherwise the diameter would be nearly 32 feet. It is now covered with large clusters of fruit.

When the Sabal stood in its old situation, it could not be seen to advantage, as the leaves were intermixed with those of adjoining Palms; now that it stands alone it has a magnificent effect, and proves that Palms, of all plants, ought to stand perfectly free, otherwise their noble outlines are almost entirely lost. Since its removal, the other Palms in line have a more commanding appearance, their straight stems nearly forming an avenue, their tops filling up, but not interfering with, the outline of the Sabal.

This tree cannot be less than sixty years old. It was removed from the stove in the old Botanic Garden, at Leith Walk, in 1822, and was kept in a lean-to house

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in the present garden for thirteen years. This house being only 18 feet high at the back and 7 feet high in front, it was greatly hampered. During 1834 a new house, 42 feet in height, was erected for Palms and other tropical plants. The Sabal was removed into it during 1835, where it succeeded well, and was thence transferred to the new large structure in 1858. The plant was then 30 feet high, chiefly composed of long and heavy leaves, proceeding from a thick and massive rustic-looking stem, about 6 feet in height, made up externally of the lower portions of the old leaf-stalks, thickly intermixed with long fibrous network or "reticulum." The leaf-stalks were all divided in the middle, and the two ends firmly attached to the opposite sides of the stem. About twelve years ago the whole of the old leaf-stalks and reticulum came off, and exposed the bare stem; since then it has increased rapidly, but the leaves and leaf-stalks are smaller in size, and the fibrous material less abundantly produced. This hemp-like substance seems to be required most while the plants are comparatively stemless, the leaves being then more or less in an upright position. This substance, which is produced along each edge of the lower portion of the leaf-stalk, is at first like strong woven cloth, closely attached, and as it encircles the base of the other leaves, and is aided by the overlapping of the foot-stalks of neighbouring leaves, it greatly assists their upright position; otherwise, their weight would probably bring them to the ground. After a time, the network, particularly at the lower part of the stem, appeared as if teased out into a bundle of rough hemp among all the lower leaf-stalks. This was particularly noticeable before their removal from the plant in 1862. After the formation of the stem, the upper leaves become more pendent, and the reticulum in consequence does not appear to be so much required, as less seems to be produced. When a leaf is first formed, the centre portion of the stem at that place must be small, and the base of each leaf-stalk must be united. As the stem thickens by age the base of the leaf-stalk begins to divide in the middle; as it goes on enlarging the division increases, till the two ends of the leaf-stalk are found to be fixed, one on each side of the stem as above

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described. Since the stem has become bare about 150 ring markings have become visible. On the lowest part, for about 4 or 5 inches, they are close together. Above this they vary in breadth from 1 to 2 inches; and the upper ones are from an inch to half an inch apart. The rings or circles are of unequal breadth, and each has the rudiments of two scars, some being more prominent than others, which indicate the attachment of each half of the leaf to the stem, one exactly on each side of a ring. No regular system is observable, although the existing leaves show something like a spiral arrangement. It is evident from the scars that each ring indicates the number of leaves which the plant has produced.

The peculiar structure at the base of each leaf-stalk enables the leaves better to withstand a gale of wind in its native condition.

[The plate of *Sabal umbraculifera* is reproduced from the *Gardeners' Chronicle.*]

III. *Extracts from Letters from W. H. Gilbert, Esq., Rangoon, to P. Neill Fraser, Esq.*

The scenery in the interior of Burmah is wondrously beautiful, and its botanical stores but poorly described, though I should say that an insular position would eclipse it in the variety and persistency of ferns and other shade-loving plants.

The filmy ferns of Burmah die down more or less in the dry season, when alone it is pleasant, and in some parts practicable, to search for plants, and thus many lovely varieties remain undiscovered. Those which retain their foliage are only, as a general rule, found on the tops of the highest hills, and fade quickly when brought to the plains.

I am obliged to you for the notes on the distinctions between *Platycerium grande* and *Wallichii*. Unless memory fails me, I have seen four or five distinct varieties of Platycerium, differing much in mode of growth, shape, &c. I hope to visit the Moulmein jungles ere long, and will try to obtain some plants. I know where a variety is found, in which the fertile fronds are said to be 15 to 18 feet long.

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I have a correspondent in the locality; but it would be all but useless, and very expensive, to obtain such huge masses as have been described. Rev. Mr Parish got a small supply, but did not, I believe, succeed in sending it alive to England.

Adiantum Parishii defies me to grow it. I have not a plant left. So far as I know it has never been grown in England. I sent Dr Hooker fresh ripe spores, but they did not vegetate. It is a little gem, fit companion to the filmy ferns growing around, and almost smothering the lovely *Cœlogyne Reichenbachiana*, among the hills in the interior. I hope to visit its habitat during my trip to Moulmein, and if I succeed will send you a few specimens. I have never seen it growing but on the surface of a huge stalactite hanging from the side of a limestone mass. The descending water had formed innumerable furrows from top to bottom, one to two inches apart, and the intervening ridges were densely covered with its tiny fan-like fronds of green and reddish-brown green of various tints, according to their age. When I came across it, unexpectedly, I made the Burman who was with me push the little "dug-out" (*i.e.*, boat made out of a small tree) some few yards back, and I then had such a feast in admiring the thousands of plants as I shall not easily forget. It seemed like sacrilege to touch such a mass of exquisite simple beauty; but I took a few roots, though it was not easy to detach them from the stony deposit, or to break off small bits of deposit with the growing plants.

The Rangoon district has been much denuded of orchids. Its alluvial plains do not produce many varieties of ferns, and few of the filmy sorts. The sides of rocks and gullies are their favourite haunts, and some exquisite ones have been brought to me, but I never could induce them to live in the plains during the dry season; and it is the same with many of the finest orchids,—the heat kills them, or else they get so parched that when the rains set in they grow so fast as to become succulent and rotten. Phalænopsids—the choicer kinds at least—have become very rare here. Although Singapore is looked upon as the emporium for *P. amabilis*, *P. Schilleriana*, *P. grandiflora*, &c., yet two friends of mine who went

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there to obtain specimens of every orchid procurable, returned with only a few roots. They say that good Phalænopsids are scarcely to be had in Singapore for love or money. Fresh supplies brought in are eagerly bought up. *Ph. cornu-cervi* is rather common here, but *P. Lowei* is, so far as I know, only found in one spot. I can testify that few plants are there now, and those so inaccessible that we can only admire their beauty at a distance. It is a delicate plant and most difficult to grow, and unless a new habitat is found, I fear it will in a few years be extinct. A good, or even a moderate sized plant is a rarity here. Could you see this orchid as I have, with foliage as large as that of *Ph. amabilis*, and flower stems 3 feet long, with 2 or 3 branchlets, I am sure you would admire it. I think it exceeds any Phalænopsis for beauty of shape or colouring. I have just received a few specimens, which will be the last I shall perhaps ever get. *Ph. Parishii* is seldom found growing freely except on trees near streams.

I lately heard of upwards of 14,000 *Cypripedium nœvium* having been collected for one shipment to England from Singapore. Where such a "clearance" is made at one time you can easily imagine how soon certain plants become rare, even in their own habitats.

The label "found at Moulmein" attached to so many Orchids is a misleading term to persons in England. Probably not one of these plants has been found in the town of Moulmein or near it, except perhaps *Dendrobium formosum*, *D. secundum*, *D. cuspidatum*, *Sarcanthus Parishii*, one or two common insignificant *Vandas*, and here and there one or two *Saccolabium Blumei*. Mr Parish keeps one or two native collectors, who go far into the interior and bring in plants. If found acceptable, they are sent for more of the same kind.

Some orchids are very local. You generally find a number about the same spot, while elsewhere you cannot find one. Again, the leafless bulbs of some of the Dendrobes are so much like the dry branches of the trees on which they grow, that unless you see them in bloom they are not easily detected. *D. barbatulum* in this way long evaded my search. The Aerides and Saccolabes are, however, easily recognised.

The flowers and shrubs commonly cultivated here are

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Ixoras, many varieties, Jasmines, Hibiscuses, Clerodendrons, Amherstia, Lagerstrœmias, *Thunbergia laurifolia*, &c. Gesnerads, including Achimenes, Gloxinias, Tydeas, Plectopanas, Gesneras, Eucadonias, Beglandularias, succeed well during the rains, but Hyacinths, Tulips, Crocuses, and such like, will not grow.

IV. *Notice of the Plant which yields the Drug called Boldo.* By Professor Balfour.

Professor Balfour exhibited from the Museum of the Botanic Garden specimens of the Boldo plant, which had been recently presented by S. Williamson, Esq. The drug called Boldo has lately been noticed as a tonic, and as also acting on the liver. The plant, whose leaves furnish the drug, is *Boldea fragrans*, of Jussieu, its synonyms being *Peumus fragrans*, of Persoon; *Peumus Boldus*, of Molina; and *Ruizia fragrans*, of Ruiz and Pav. It is a native of the mountainous regions of Chili, and belongs to the natural order Monimiaceæ. It is a small deciduous tree with opposite aromatic leaves containing an essential oil. An alkaloid called Boldine is said to be yielded by it. The plant is figured in the Botanical Register, xxxi. t. 57, and Lindley's Vegetable Kingdom, p. 298. Dr W. Craig stated that he had recently used the drug, but had failed to find it to be of the slightest value.

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14*th January* 1875.—Professor BALFOUR in the Chair.

The following communications were read:—

I. *Note on the Geological Range of* Adiantites Lindseæformis, *Bunbury*. By R. ETHERIDGE, jun., F.G.S.

The beautiful fern described by Sir Charles Bunbury under the above name in the Geological Survey Memoir, relating to the Edinburgh district (Mems. Geol. Survey, 32. Scotland, p. 151, fig. 26) is particularly characteristic of that section of the Lower Carboniferous series, known as the Wardie Shales, probably a brackish water or estuarine deposit, exceedingly well developed in this neighbourhood. About twelve months ago Mr A. Paton of East Kilbride, Lanarkshire, very kindly forwarded to the Geological Survey Office a collection of marine corals, mollusca, polyzoa, and crustacea, collected by himself from a bed of shale overlying the Calderwood cement stone at the Kirktonholm Cement Works, East Kilbride. Associated with these marine organisms were the remains of numerous ferns, principally *Sphenopterids*, but amongst them a very fine specimen of *Odontopteris lingulata*,* Schimper, and several fragmentary specimens of *A. Lindseæformis*, differing but little from typical specimens obtained from our Lower Carboniferous shales. The specimens of *Adiantites* from Kirktonholm Cement Works appeared from their state of preservation to have undergone a good deal of maceration previous to fossilisation, and were in all probability drifted examples. The specimen exhibited shows the terminal smaller and more elongated pinnules as distinguished from the expanded fan-shaped pinnules of the lower parts of the frond, and also has the upper margin of each individual pinnule not quite so rounded or arched as in specimens from this neighbourhood. Mr J. Bennie, fossil collector to the Geological Survey was fortunate enough to find a fragmentary specimen of *A. Lindseæformis* at another locality in the East Kilbride

* Which was kindly determined for the writer by Mr W. Carruthers, F.R.S., of the British Museum.

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district—Burnbrae old quarry. We thus have the fern from the Wardie Shale section of the Lower Carboniferous series, and the Calderwood section of the Lower Carboniferous Limestone (Marine) series.

II. *On the Contents of the Crop of the Capercailzie* (Tetrao urogallus). By M. DUNN, the Palace Gardens, Dalkeith.

Having had an opportunity of examining the crops of several capercailzie, with reference to their destructiveness to forest trees, it has been suggested that the results of my examination might be of interest to the members of this Society, and in accordance therewith I have drawn up the following note.

In the crop of a male bird, which I examined on November 15, 1873, I found the contents to be as follows:—203 points of shoots of Scotch fir with the leading bud entire, some of the shoots being fully 3 inches long, and 2 inches wide, measured across the leaves as taken out of the crop; eleven pieces of young wood, 1½ to 2½ inches long, and about an inch in circumference at the thick end, each having some leaves attached but no terminal bud; and fifty-two buds: making in all the enormous number of 266 shoots and buds of Scotch fir, besides a large handful of detached single leaves of the same, devoured by one average-sized bird at a single meal. The bird weighed 11¾lb., the crop weighing 9 oz., and measuring 6 inches in length, 5 inches in breadth, and 3 inches in depth; its circumference being 15 inches the longest way and 12½ inches the shortest. The leaves, buds, and shoots, were all quite fresh and green, apparently selected with good taste from healthy growing trees.

I examined the crop of another rather small male bird on April 16, 1874, and found the contents to consist entirely of the young shoots, buds and leaves of larch, excepting three small bits of lichen, probably picked off the same tree. I counted five pieces of young shoots, each over an inch long, and the extraordinary number of 918 buds with or without leaves attached, and an ordinary sized teacupful of

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tender young leaves. The contents in this case were very moist and sticking together in small bundles, but separated easily. All were plump, juicy, and fresh, evidently the produce of a free healthy growth. The bird weighed 9½lb., its crop when full weighing 7½oz., the weight of the contents being 6½ ounces. Its length was 4½ inches, breadth 2¾ inches, depth 2¼ inches, and circumference, the longest way 12 inches, the shortest way 7½ inches.

By the above analyses of their crops, which are similar to many I have examined in the winter and spring, it will be seen that where Capercailzie are numerous they must do considerable injury to larch and Scotch fir plantations, although their food is by no means confined to the produce of those trees, as at other seasons I have examined crops which contained (besides larch and Scotch fir) various sorts of berries, such as junipers, mountain ash, or "rowans," haws, hips, brambles, cranberries, blackberries, &c., generally mixed with a few leaves of the same plants; and sometimes the leaves and buds of birch, hazel, and oak, but the latter is rare. In July and August I have found some crops filled with nothing but the young tops and bloom of heather, *Erica cinerea* and *E. Tetralix*, both species generally intermixed, neither seeming to be preferred. In birds of the first year there is generally found a large quantity of fern fronds and less of the Scotch fir, which at all times afterwards seems to form their staple food. The fern fronds are almost wholly the common Polypodium (*Polypodium vulgare*), but occasionally I have found small quantities of the male fern (*Lastrea Filix-mas*) the lady fern (*Athyrium Filix-fœmina*) and *Lastrea dilatata*. Barley and oats are also found in the crops of birds when got in the neighbourhood of cultivated land, but I have never found them in any quantity; and in all the specimens I have examined, young or old birds, I have never found a single morsel of spruce fir, although the bird is said to feed freely upon it in Norway.

From my own observation, and in reply to inquiries I have made of people who are in the habit of observing the capercailzie feeding in the northern forests, I believe it prefers to feed upon the healthy young "sappy" growth of vigorous trees, and they have been known to return to the

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same tree day after day until they had completely denuded it of healthy young buds and points of shoots; however, I believe cases of such severe injury are rare, and, generally speaking, if the birds are not too numerous, the injury they do is trifling compared with the great pleasure and gratification of seeing such a magnificent bird again becoming common in the forests of our native country.

[Mr Dunn opened before the meeting the crop of a female capercailzie which had been shot in Perthshire the previous day. The crop was filled with the leaves and buds of the Scotch fir.]

III. *Notes on* Pinus Austriaca, &c., *in Scotland.* By Sir John Murray Nasmyth, Bart.

I believe I induced the late Mr Lawson to bring to Scotland seeds of *Pinus austriaca.* I corresponded for him with Professor Hess, at Vienna, having passed some time there in 1825, and visited the district where the "Schwarzkiefer" grows. I then thought over the possibility of introducing this beautiful pine to Scotland. Being a zealous planter, I arranged with Mr Lawson to have the first crop of plants, and accordingly, in the spring of 1836-7, I planted forty Scots acres, mixing the Tyrol larch with *P. austriaca.* In the spring of 1852 nearly the whole of this young wood was burnt, in consequence of workmen smoking whilst making a road in this part of the wood. Mr Lawson, however, made a great mistake in planting the *P. austriaca* on a very high and exposed part of my hills. What remains of this wood has never succeeded well; they are mere sturdy stumpy trees, and are year by year dying out. Subsequently I planted very extensively over my woods (which average 800 to 1000 feet above the sea), as well as through the lower grounds. The result of my experience is that *P. austriaca* will never make a lofty tree in this hilly country. Even in its limited habitat (in Lower Austria, between Vienna and the Sömmering Mountain Pass) it is always a low-growing, and never a large tree.

This tree, as is well known, is so rich in resin (called by the Germans *harz*) that its chief use in the country

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where it grows is for lighting the houses. The wood is split into very thin "laths," about two feet long, kept in bundles, and used as candles. I passed a whole summer in the Upper Engadine, and while there made the acquaintance of the head forester of the district between Samaden and Sylva-plana. He had formerly had the charge of a great district of forest in the Rhine country—the Eifel. He told me, in answer to my inquiries as to his knowledge and experience of *P. austriaca*, that the tree had been largely introduced into the German forests of Thuringia, Taunus, Eifel, Schwarzwald, and the Pomeranian forests, and that it had been found to give way after thirty to forty years; the timber also was considered quite inferior to *P. sylvestris*, owing to the superabundance of *harz* (resin); in fact, it could hardly be sawn or worked. I find this information sadly true. Those I have planted in my hill woods, mixed with *P. sylvestris*, have attained no size for their years, and are almost without exception dying off; the foliage seems to wither and brown, the tree exudes low in the trunk a quantity of resin, and those I have cut down have with difficulty been sawn, owing to the amount of resin.

When passing an autumn (1863), at Ischl, in Upper Austria, I had the same information given me by the Emperor of Austria's head gardener, who, I remember, was busy transplanting some large specimens of *P. austriaca* (October): he told me they were merely ornamental, and did not succeed on the mountains.

In Mr M'Nab's pamphlet on the change of our climate, he alludes to the larch. Mr M'Nab is aware, I think, that the first larches planted in Scotland were here (Dawick, Stobo, N.B), brought by my grandfather from Tyrol as seed, and put out in 1725!—(this is an authenticated fact)—six years before those at Dunkeld. These great trees are now sadly torn, one lately (October 21–22), but the great one was torn in 1820, and one magnificent tree is quietly dying out. All my young larch plantations I raised from seed sent me by Appelius & Eichel, from Erfurt. I am convinced that one cause of the so-called larch disease arises from want of timely thinning, as well as from home-grown seed; I have thinned my larches early and gradually, always insisting upon having room

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for sun and air to the roots, and I have never had any disease.

As to the Arve, *Pinus Cembra*, I have pruned some, and find they do not bear it so well as *P. austriaca*. They are growing very luxuriantly, but for some years past have been sadly injured by the boring beetle. The *P. ponderosa*, of which I have one large tree, is a miserable-topped unsightly tree, and is especially preferred by the borer.

The *P. pyrenaica* has almost entirely failed with me. Being a Spaniard, it lacks sun in Tweeddale. The true *P. uncinata* grows a pretty diminutive tree. The tree named by nurserymen in their lists as *P. uncinata* is nothing but the *P. Mugho*.

IV.—*On the Ferns of Brisbane.* By Robert Grieve.

The number of ferns which I have been able to gather within twenty miles of the town of Brisbane, exclusive of Lycopods and Equisetaceæ, is in all fifty-five species. Every river is skirted by a great fluvial forest to a breadth varying from a few yards to a few miles. Dense, moist, gloomy, the nocturnal mosquito here hums its war-song at noonday. The large fig trees of various kinds, the red cedar (*Cedrela Toona*), the gigantic nettle (*Urtica gigas*), and the Seaforthia palm are abundant. At our feet are various growths allied to Maranta and Caladium. Above our heads are festoons of creepers, while at every step our progress is impeded by some wait-a-bit thorn, or the vines and lianas that bind the whole together. Such are the localities which produce some of our finest ferns. First of all is the tree fern, Alsophila, which rises to the height of 30 or 40 feet. I only know one species, although close to the skirts of the wood is its congener, *Dicksonia dubia*. Of the genus Pteris we have four species. *Pteris tremula*, with its polished ebony shafts, and the larger and more graceful, *Pteris vespertilionis*, 10 feet high. The two other species are the ubiquitous *P. aquilina*, and the more rare *P. longifolia*. As we force our way through the forest, we tread on two interesting little ferns, *Pellæa paradoxa* and

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falcata. On rotting tree-stumps grow side by side, *Niphobolus-confluens* and *rupestris.* We next come upon a plant, the only one of its genus with us, *Allantodia australis.* Proceeding over the rich loose leaf-mould, we observe a most graceful fern, calculated to be an ornament to every conservatory, *Nephrolepis exaltata. N. obliterata* may also be seen adhering to rocks outside the forest, and insinuating its polished roots among loose stones, and close beside it is that curious plant, *Drynaria diversifolia.* Those apparently withered oak leaves are the first produced pinnatifid unfertile fronds, always dessicated, of that tall feathery *Polypodium.* To obtain a plant you must take the rock to which it adheres.

But let us return to the forest. Here and there, in a moist hollow of a dead tree, may be seen *Nephrodium molle,* like an immense Prince of Wale's feather; still more common, and of darker green, are several varieties of *Nephrodium decompositum.* Two other swamp-growing species, viz., *Nephrodium unitum* and *propinquum,* do not seek the shade. Allied to this genus is *Lastrea coriacea.* In the depths of the scrub, often in solid masses of many yards extent, we find the dark green *Asplenium attenuatum,* conspicuous for its proliferous reproduction. There are several varieties of this fern, some perhaps altogether distinct. A fern I discovered bears some resemblance to Asplenium, but is, perhaps, more closely related to Doodia. A much finer and larger species of Asplenium than the last, is *A. falcatum,* one of our choicest ferns. High over head, it grows in the hollows of trees, from which it throws out bunches of long dark green crescents, and is generally obtained with difficulty. So also is that beautiful epiphyte sometimes called an *Asplenium, Neottopteris australasica,* a grand fern, much like what is called the Bird-nest fern by gardeners. It attains a size at which each leaf may measure 8 feet. *Davallia pyxidata,* the Hare's-foot fern, a beautiful species, is common in British conservatories. All these epiphytes grow in similar situations, mostly in branch hollows of the largest trees, sometimes at 20 feet, sometimes at 200 feet. The most beautiful of all is without doubt, *Platycerium alcicorne, grande.* I have frequently seen it covering 100 square feet, or about 12 feet by 8.

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Another species of Platycerium not so familiar to British botanists, *P. alcicorne*, *longifolium*, is a much smaller plant and has a perfectly distinct fructification. In *P. grande*, the fructification crosses the whole of the broad disc-like fronds, whereas *P. longifolium* only bears spores upon the tips of its comparatively attenuated leaves. *Polypodium tenellum*, a creeping fern, makes its way like ivy or convolvulus up the trunks of trees, and adheres to its support by numerous fibres. It is the last of the forest ferns that I shall name, and I would observe that the nomenclature is given with diffidence. Passing from the shade of the forest, we cross the broad meadows. Here and there a gigantic gumtree or ironbark (both *Eucalypti*), intercepts the vertical rays of the sun. We see around us the ubiquitous *Pteris aquilina*, and mixed with it is the similar, but fairer fern, *Polypodium rugulosom. Dicksonia dubia* grows in compact and tall masses hard by; and *Doodia aspera* on the stony ground. *Doodia media* and *caudata* seek a moister habitat. By the shade of rocks grow two pretty little ferns, light in form but dark in colour, resembling one another, but yet distinct, *Cheilanthes Sieberi* and *Nothochlœna distans*. Out of the sun, over the broken banks of that streamlet, not far off, is the lightest, airiest, and most herbaceous of all ferns, *Lindsœa microphylla*, not in single stalks, but in great bunches of transparent vegetation. The shape of its leaf resembles *Sphenopteris affinis* of the Coal Measures. Growing near are *Lindsœa Fraseri*, *L. linearis*, *L. trifida*, and *L. heterophylla*. They form a group matchless for grace and delicacy. Two very unique ferns love the inhospitable sand, *Schizœa dichotoma*, and *S. bifida*. Their resemblance to the grasses causes them frequently to be passed over.

By the shelving banks of this stream, or among its undergrowth, may be found our three Adianta: *Adiantum formosum*, *A. hispidulum*, *A. assimile*, so called from its close proximity to the Maiden-hair of Europe. The Maiden-hair is partly shaded from the light by another fern, *Blechnum cartilagineum*, and nearly in the stream is the other species, *B. striatum*.

Conspicuous among swamp ferns, for its size and beauty, is *Todea barbata*. It has a large central crown of ver-

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nation formed by fifty fronds, each 8 or 10 feet high. Not inferior in size, if somewhat in grace, is the large *Chrysodium aureum*, which only grows on the banks of tidal streams. *Lygodium microphyllum* is a creeper, and may be seen trailing through the reeds and water plants for many yards, leaving everywhere a gay festoon as it moves along. It somewhat resembles *Tropæolum canariense*, but is more light and delicate. Lastly, we have three Gleichenias, with their simple rudimentary spores at the back of each frond, ready to drop off at a touch, *Gleichenia dicarpa*, *G. microphylla*, *G. flabellata*. They are wiry and incompressible, but eminently graceful and light.

11*th February* 1875.—Professor ALEXANDER DICKSON in the Chair.

The following Communications were read:—

I. *On the Fertilisation of the Cereals.* By ALEXANDER STEPHEN WILSON.

To the position taken in my last paper* on the fertilisation of the so-called European cereals, that these grasses were self-fertilised; that the act of fertilisation in those cases in which the flower opens is probably performed in the opening, and is necessarily confined to the twenty or thirty minutes during which the flower remains open, certain objections were taken. It was objected that I appeared to make the mistake that fertilisation took place when the pollen was shed, which, as was illustrated by the case of many plants, it was said, was not necessary.

The meaning of the word "fertilisation" is partly a matter of convention. It may mean that act of the anthers by which they project or discharge the pollen, which, falling directly on the pistil, shall produce the embryo; or it may mean the falling of the pollen on the ovule after being carried a distance by the wind; or it may apply to the

* See *ante*, pp. 84-95.

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instant in which the elements of the pollen set up that action in the ovule which produces a new plant.

It is with the first meaning that these papers are concerned. I find that many of the cereal florets never open at all, and that in the case of those which do open, part of the pollen is discharged inside the cup. The discharge and the contact may be very nearly simultaneous, or the pollen may adhere to the inner sides of the paleæ, and may not touch the stigmas until the paleæ are again squeezed close to the stigmas. It is the discharge, which is here called fertilisation, so that in florets which open and close again in twenty or thirty minutes, this fertilisation must, by its definition, take place in these few minutes. In florets which do not open, but simply become more or less inflated, the process is the same; discharge and contact closely follow each other, and this process is here called fertilisation. How long the pollen may lie dormant on the stigma, or how long it may take, in any form, to reach the ovule, I am not aware that any one has determined. If it be said that fertilisation does not take place till some of the matter of the pollen has reached the ovule, the two meanings are not contradictory, but refer to different stages of the same process.

Last season (1874) I had opportunities of observing the flowering of a wheat not referred to in previous notes. This was the Polish wheat (*Triticum polonicum*). The descriptions of it which I have seen are somewhat defective. The glumes or outer chaff-scales are more than an inch in length and somewhat shorter than the outer pale of the lowest floret, which is frequently an inch and a half in length. The inner pale of the lowest floret is less than half the length of the outer; the second floret on the spikelet is shorter than the first, the third than the second, the fourth is shorter than the third, while the fifth and sixth are rudimentary. Only the two lower florets are awned. But the peculiarity which distinguishes this from all other wheats is, that while in other wheats the inner florets of the spike reach further up the rachis than the outer and form a convex outline, the outer florets of the Polish wheat reach highest, so that the spikelet has a concave outline.

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In this wheat two of the anthers are usually enclosed within the reflexed edges of the inner pale. They are pushed upwards in flowering. But the outer pales of the two lower florets are so large that the filaments of the anthers never acquire length to carry the anthers outside. They are not prevented from getting outside, as in some other wheats, by the edges of the outer pale enfolding the edges of the inner. The two pales are quite unconnected, and the anthers, though free to come out, are overlapped by the great size of the outer pale. The anthers of the third and fourth florets sometimes appear outside, when hanging favourably for falling out between the pales. But, from the structure of these pales, almost all the pollen must be discharged inside; so that cross-fertilisation seems to be very rarely possible. And, from some peculiarity unknown to the writer, self-fertilisation was less successfully accomplished in this wheat than in others growing beside it.

In order to test more fully whether self-fertilisation was adequate, or whether foreign pollen was necessary, two clear bottles were attached to two poles inserted in the ground, and into each bottle an ear of barley, near the time of flowering, was introduced, and the bottles corked, leaving only a notch for the culm. They fertilised and ripened in the bottles as if no bottles had been present; one presenting two barren florets, which may often be seen in ordinary culture, the other being fully fertilised. Into each of two other stone bottles, and therefore dark, two ears of wheat were introduced, as in the previous case. These ears were as fully fertilised in the dark bottles as the same wheat in the open air. But I discovered that such experiments were being performed in all directions through the corn fields, and that I had only to read off the results.

In fields of barley I found here and there solitary ears of oats; they were as fully fertilised as the ears in oat fields.

In a field of oats I found two spikes of spring wheat and no others, and there was not a field of wheat for miles from the spot in any direction; they were both, in succession, fully fertilised.

In various oatfields solitary ears of various barleys were

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found, and all were as fully fertilised as if they had been surrounded by flowering barley.

In a field of hay, which had carried oats the previous year, a good many dwarfed panicles of oats were found, struggling up from the seeds which had lain through the winter. Some of them carried but a single floret, some two or three, some five or six. They were all fully fertilised.

On roads and railways here and there dwarfish specimens of the cereals were also found, and fertilisation in these was as completely effected as if they had been taken from the midst of thousands of others.

At a later period of the season, after the crops were ripe, turnip fields threw up a green panicle here and there, and in these also fertilisation was in no way deficient.

Of course it is well known that some of the pollens may be carried to great distances. The pollen of the cereals, in the condition in which it is discharged, falls in air with considerable rapidity. The flowers of wheat, barley, rye, and oats, which do open, remain open but for a very brief period. Only two or three florets on a spike are open at one time. Unless, therefore, a constant stream of pollen were passing over a spike of wheat for a week, it could not be wholly cross-fertilised. This would require the concurrence of a properly directed wind, and that the fertilising source should be at the same stage of maturity as the subject to be fertilised. In the case of oats, the locusta of which is pendulous, and the ovary of which is covered from above, cross fertilisation could only be effected by pollen moving first in a horizontal direction, and then rising up into the flower against the force of gravity. That single ears of wheat growing miles away from all other wheat, or panicles of oats six inches above the ground amongst the roots of grass, or ears of barley enclosed in bottles, should be cross-fertilised, seems impossible.

A former paper may have given the impression that all the florets of wheat, rye, barley, and oats close again in twenty or thirty minutes. There are some exceptions to this in the case of rye. Some of the florets of rye never close after opening. Now, if it were the case that the

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spikes of rye were more fully fertilised than the spikes of barley, this fact, coupled with the possibility of cross-fertilisation, might be held to explain this fuller fertilisation of rye. But further observation confirms the fact previously stated, that rye is the most imperfectly fertilised of the four grasses under review.

Certain botanists have assumed the responsibility of maintaining that Nature abhors self-fertilisation. If she does, her practice falls short of her principle. But what is self-fertilisation? and what is cross-fertilisation? Consider a wheat plant. The seed falls into a poor soil, and only a single stem and a single spike is produced. The pollen and the ovule enclosed in each floret have a certain relationship to each other; what that relationship is, in terms of the production of a new plant, we do not know. But is this relationship between the pollen in one floret and the ovule in another floret of the same spike a different relationship from that between the pollen and ovule in the same floret?

Suppose, again, that the seed falls into a rich soil, and produces fifty stems and fifty spikes; is the relationship between the pollen on one spike and the ovules on another, different from the relationship between the pollen and ovule in any single floret?

Suppose, further, that a wheat plant of fifty tillers is torn asunder when young, divided into ten plants, and grown in ten different fields. Is the relationship between the pollen of one plant and the ovules of another, different from the relationship between the pollen and ovule of a single floret in the supposed single stem?

If what is usually called cross-fertilisation—the conjunction of pollen from one floret with the ovule of another—bring different elements together from those brought together by self-fertilisation, this is a physiological difference of real value. But if in "cross" fertilisation the pollen transferred contains nothing but what is contained in the home pollen, then cross-fertilisation and self-fertilisation, dealing with the same elements, are physiologically identical. To call the process self-fertilisation when the pollen comes half an inch to the stigma, and cross-fertilisation when it comes half a dozen yards, seems to be the

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making of a distinction in advance of any real knowledge. If a botanist, by using the word cross-fertilisation, wishes his hearer to understand that a different vegetable element is involved when he uses the term self-fertilisation, it is incumbent on him to fix in his own mind what is his own meaning.

II. *Deciduous Trees in Winter.* By James M'Nab.

A very general belief seems to prevail that it is impossible to distinguish the various forest trees when stripped of their foliage. But the pleasures of a country walk in winter may be greatly enhanced by a recognition of the bare trunks and leafless branches that surround us, and by being able to tell every tree as it comes into view. I shall endeavour to describe the general arrangement of the terminal branches and spray of some well-known forest and ornamental trees; more particularly as they appear in early winter. As the season advances they become more dense, owing to the gradual swelling of the young buds. The practised eye, however, is always enabled, from the disposition of the spray, to recognise them in their different stages. The Ash tree has frequently an irregular outline of head, generally with long undulating branches, particularly on trees standing free. The twigs are somewhat dichotomous, thickened at their points, and project considerably beyond the secondary or side spray. The spray has a loose appearance, and shows a uniform openness all over the tree. The Beech tree has generally a well-developed and regular outline, the main branches tapering gradually. The points, for the most part, proceed at right angles from the branches, and have an undulating appearance. The side spray is short, and generally turns upwards. The extremities of the branches, for about 3 or 4 feet all over the tree, show a uniform lightness. The bark of the tree is smooth, and generally of a grey or leaden colour. The Birch, when standing free, has often a regular and graceful outline. The points are principally composed of small twigs of uniform thickness, either upright or weeping, generally showing a somewhat netted appearance. The stem is well known by its white bark. The Horse-chestnut generally shows a regular out-

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line, composed of numerous sturdy branches, the lower ones drooping. The branchlets are not crowded; a foot or two of each point turns upwards. They are strong, of a uniform thickness, and somewhat open and regular all over the tree. The bark is greenish-grey and partially roughened. The common Chestnut, when standing free, has a regular outline of head, the branches strong and pendent. The extremities are numerous, and thickened toward the points. Although the main branches are pendulous, the points are generally bent upwards, and show a uniform thickness all over the tree. When old, the bark assumes a corrugated and rough appearance. The outline of the English Elm is frequently very irregular, most of the branches projecting upwards, some beyond the rest, The terminal spray is more or less upright, twiggy, and with a confused appearance, the darkest part being 10 or 12 inches below the points of the twigs. The bark is generally dark and rough. The outline of the Scotch or Wych elm, although somewhat regular, has the upper branches as well as the spray in long forked lengths, more or less diverging. On this account it frequently receives the name of the Y tree. About 2 feet from the points of the branches is generally the most open part all over the tree. The outline of the Lime tree is regular and the head somewhat rounded. The spray is thickest about 1 foot within the general outline. The terminal branches and spray are upright, and the lower side branches more or less drooping, with a tendency to turn up at the points. The bark is somewhat smooth, and generally green, being covered with a small cellular plant known as *Chlorococcum vulgare.* The common Oak has an irregular outline. The main branches generally diverge much, as well as the secondary and terminal ones; the points of all protrude from 2 to 5 inches beyond the numerous semi-whorls of small side spray, which generally inclines upwards. The bark is rough, and of a dark colour. The Turkey Oak is generally very tall, with an irregular outline; the main, as well as the top branches, more or less erect, and generally in long, straight shoots, their sides being covered with spray a few inches long. The general density of the spray is not great, but uniform, except at the points, which are long and stand free. The black Poplar has rather an irregular out-

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line, composed of large massive limbs, the smaller branches ramifying much towards the points, giving the outline of an old tree a netted appearence, always thickest about two feet within the general outline. The Robinia has a very irregular shape; the main branches generally assume a tortuose or zigzag appearance, which is observable even at the extreme points. The branchlets and spray are short; a uniform lightness is observed all over the tree. The Sycamore, or Scotch Plane, has generally a regular outline, composed of large massive branches, each portion more or less rounded, and terminated with numerous tesselated points, turned upwards and slightly thickened, generally darkest round the outline of the tree. The bark is frequently green with Chlorococcum, and somewhat rough. The outline of the Walnut is often very irregular, and branches much. Many of the branches, as well as the tops, are somewhat dichotomous. The terminal, as well as the side spray is strong, and has a uniform openness throughout. The Willow, when large, is generally composed of low bending stems, their points assuming a slightly elevated habit, and as they ascend, the upper portions become more or less erect; a uniform openness is all over the tree.

III. *Note on the Drug called "Jaborandi."* By William Craig, M.D., C.M., F.R.S.E.

Dr Coutinho, of Rio Janeiro, has lately introduced to the notice of the medical profession a new drug, which possesses remarkable properties as a sialogogue and diaphoretic. Jaborandi, the Indian name of this new medicine, is a shrub which grows in the interior of certain provinces of North Brazil. The parts used are the leaves and small branches. From these, when bruised, an infusion is prepared which possesses the remarkable properties of the drug. It is now fully a year since a small quantity of this plant was brought to Paris by Dr Coutinho; and Professor Gubler, after experiments at one of the hospitals of Paris, declares that the effects of Jaborandi are extremely remarkable and the evidence irresistible.

Owing to the difficulty of procuring the drug, little, if any of it reached this country till the beginning of this

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year. It was on the 5th January that I received the first packet I believe that came to Scotland. Since then I have received sufficient to enable me to ascertain its physiological properties; but of various experiments I have performed with this drug, I shall merely refer to the general results. I shall afterwards give, so far as known, the botanical characters of the plant. An infusion of one drachm of the bruised leaves produces the following results:—About twenty minutes after the infusion is swallowed, salivation commences, and in a few minutes afterwards, the mouth is literally flowing with water. This continues for four or five hours, and during that period from ten to sixteen ounces of fluid may be easily collected. Some observers state that this fluid is alkaline; but I have invariably found it acid. I may mention that the infusion is acid, has a peculiar odour, is not unpleasant to the taste, and I have never found it produce any nausea. Notwithstanding the large amount of fluid secreted by the salivary glands, it produces no uneasiness in these glands. Simultaneously with the flow of saliva, perspiration appears on the forehead and the whole body. It extends to the limbs, but is most marked on the trunk. These effects can be produced in a temperature ranging from 54° to 56° Fahr., and without putting the patient to bed. It is not necessary to administer the infusion hot. The effects are produced when the infusion is cold. It appears to act by directly stimulating the sweat-secreting glands. The sweating continues for several hours.

I have not had much opportunity of testing its therapeutic virtues, but have tried it in two cases of fever, where the tongue was dry and the mouth parched, and by giving small doses of an infusion every few hours, I was enabled to restore the flow of saliva, and to keep the tongue and mouth moist. I believe it will in this respect be of considerable use in fevers and other diseases.

There can be no doubt that this drug possesses remarkable powers as a sialogogue. Certainly I know no medicine to be compared to Jaborandi in this respect. Its power as a diaphoretic is also well established, although I did not find it so remarkable as I had anticipated from reading the account of Professor Gubler's experiments.

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M. Rabuteau, of Paris, has made a chemical analysis of the leaves of Jaborandi, and finds that they contain 1. A volatile principle; 2. A part soluble in water, and perfectly flavourless; 3. A part insoluble in water, but soluble in alcohol, and having a bitter flavour; and by experiments he has come to the conclusion that it is the last in which all the virtues reside.

This appears to be an erroneous conclusion, for it is clear from my experiments that the infusion possesses the power of producing the chief, if not the whole, physiological properties of the drug. I put some bruised leaves in proof spirit after they had been exhausted by infusion, but failed to get from this tincture the remarkable properties of Jaborandi.

With regard to the untoward results which sometimes follow the administration of this drug, such as nausea and vomiting, I believe most, if not all, of these are due to the fact that the "dregs" were swallowed as well as the infusion. These "dregs" consist to a great extent of pieces of the stem, leaves, and petioles. There is a large amount of fibrous tissue in these dregs, and irritation of the stomach and alimentary canal must follow. In the *Pharmaceutical Journal*, 1875, p. 561, Mr Martindale, of London, relates an experiment in which he swallowed about 50 grains of the "dregs" in addition to the infusion, and experienced nausea and vomiting. This was the natural consequence of swallowing such an amount of indigestible matter. In the article referred to he adds this sentence:—"The strained infusion, from what I hear, produces but little effect." In the *Pharmaceutical Journal*, 1875, p. 574, I described an experiment performed with the strained infusion, followed by remarkable effects.

May not the disturbance of vision noticed by Mr Martindale be due to the same cause as the sickness and vomiting?

The following may be regarded as ascertained facts regarding Jaborandi:—1. The leaves are possessed of remarkable sialogogic and diaphoretic properties. 2. Boiling water is capable of extracting the most, if not the whole, of these properties. 3. A strained infusion seldom produces any untoward results. 4. On account of the large quantity of

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indigestible fibrous matter in the "dregs," these, when swallowed, produce unpleasant effects. 5. The dose of the infusion will be found to correspond to only a very few grains, posssibly only two or three grains of the leaves.

There is considerable doubt as to the botanical source of Jaborandi. Some maintain that it belongs to Piperaceæ, while others assert with more probability that it belongs to Rutaceæ.

I believe that the name Jaborandi is given by the Brazilians to various plants possessed of stimulating properties, and in a Portuguese dictionary of Brazilian medicines, by Dr Chernoviz, published in 1868, Jaborandi is mentioned as the produce of *Ottonia Anisum*, Spreng. a plant belonging to Piperaceæ. Dr Chernoviz states that this plant is possessed of sialogogic properties, and that from the root a tincture is made (1 of Jaborandi to 8 of alcohol). From the parts of the plant I have examined, I may safely say that the Jaborandi of Dr Chernoviz is not the drug now attracting so much attention in Europe.

There is a plant at present in the market called "Piper Jaborandi," whose virtues I have not yet had time to investigate, but certainly it is not the *true* Jaborandi. The leaves are very different from those of the shrub whose effects I have described in this paper.

I have not been fortunate enough to receive those parts of the plant required to determine its botanical source; but the following facts have been ascertained.

The leaf is compound, impari-pinnate. The leaflets are four or five pairs, and scarcely opposite. They are glabrous, smooth, brittle when dry, and somewhat resemble the leaves of the *Prunus Laurocerasus*. They are elongated, elliptical, emarginate, and slightly unequal at the base. The leaflets vary much in size and in form, even on the same leaf, but the foregoing characters are possessed by all. The venation is well marked and very beautiful. There is a prominent mid-rib on the under surface, running along the entire length of the leaflet, from this mid-rib numerous veins proceed (at an angle of about 45 deg.) towards the margin of the leaflet, and form loops and anastomoses within the margin of the leaflet. The veins are well seen on both surfaces, but are most marked on the under side of the

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leaflet. The petiole is cylindrical, flattened and thickened at the point of insertion into the stem. The distance from the stem to the first pair of leaflets varies in my specimens from 2 to 5 inches, the average distance between the pairs of leaflets being about 2 inches. The leaflets are nearly but not quite sessile, and are *inserted on the* upper surface of the petiole. They are thickly spotted with pellucid dots. These are well seen when the leaflet is held before a bright light. From an examination of sixteen leaflets, I find the average length is five inches, and the average breadth at the broadest part 1½ inches. I have seen specimens of the stem and small branches, the diameter of the largest piece being about ½ an inch. The bark peels off loosely, is very brittle, and produces a peculiar sensation when chewed. Between the bark and wood there is abundance of crystalline matter, but I failed to find any definite forms of crystals when examined under the microscope.

IV. *Notice of stations for Rare Plants near Edinburgh.* By Robert Kirk.

The plants mentioned in the following list were collected in the autumn of 1873, and spring and summer of 1874, when I was competing for Professor Balfour's Herbarium medal. All the localities noted are not new, but where a well-known habitat is given, it will show that the plant is still found there.

Ranunculus arvensis, *L.* Dirleton.
Caltha palustris, *L.*, *β* minor. In considerable abundance on a small stream on the West Lomond Hill.
Helleborus viridis, *L.* Arniston.
Chelidonium majus, *L.* St. David's, on the ballast heaps.
Hypericum grandifolium, *Choix.* Water of Leith near Currie.
Malcomia Chia, *DC.* do. do.
Eruca vesicaria, *Cav.* do. do.
Erysimum orientale, *R. Br.* do. do.
Iberis amara, *L.* Waste ground near the Battery at Burntisland.
Saponaria Vaccaria, *L.* On the Granton Railway.
Silene noctiflora, *L.* Fields near Largo.
Lavatera arborea, *L.* Burntisland.

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Hypericum calycinum, *L.* Donibristle.
Geranium Phæum, *L.* Binny Crag Wood.
Ononis campestris, *Koch.* Musselburgh; and common on both sides of the Forth.
Vicia lutea, *L.* Embankment of the Granton Railway.
Lathyrus Aphaca, *L.* do. do.
Ornithopus perpusillus, *L.* Burntisland, ballast heap.
Rosa alpina, *Desv.* Near Penicuik.
Lythrum Salicaria, *L.* In great abundance on the banks of the Esk between Polton and Lasswade.
Sedum anglicum, *Huds.* Between St David's and Donibristle, covering a large mass of rock on which *Allium Scorodoprasum* grows.
Saxifraga sarmentosa, *L.* Binny Crag.
Telima grandiflora, *Lindl.* do.
Astrantia major, *L.* do.
Fœniculum officinale, *All.* Charleston ballast heaps.
Pastinaca sativa, *L.* Banks of Esk at Auchindinny.
Heracleum Sphondylium, *L.*, β angustifolium. Waste ground near Gosford.
Aster Canadensis. Near St David's on ballast.
Cichorium Intybus, *L.* North Queensferry, above the Quarry.
Senecio viscosus, *L.* In great abundance on many of the coal heaps near Armadale, although very rare usually in that locality.
Jasione montana, *L.* St. David's, ballast heaps.
Verbascum nigrum, *L.* On an old garden wall at Largo House.
„ Lychnitis, *L.* do. do.
Linaria Pelisseriana, *Mill.* Ballast at Elie.
Calamintha Acinos, *Clairv.* In small quantity at Dirleton.
Lamium Galeobdolon, *Crantz.* Kingswood, near Burntisland.
Marrubium vulgare, *L.* Waste ground west of the race course, Musselburgh.
Plantago media, *L.* Burntisland.
Gymnadenia albida, *Rich.* Near the Farm House, Knock Hill Bog near Dunfermline.
Allium oleraceum, *L.* Burntisland Harbour, near the castle.
Alisma ranunculoides, *L.* Loch Leven, near Kinross.
„ „ β repens. *Dav.* Shore of Loch Leven, near the Bishop Hill.
Apera interrupta, *Beauv.* Still in abundance at Dirleton Common, and also at St. Davids.

Ægilops triaristata, *With.*
Dactylis hispanica, *Roth.*
Festuca loliacea, *Huds.*
Bromus Madritensis, *L.*
Serrafalcus racemosus, *Parnl.*
Echinaria capitata, *Desv.*
Secale cereale, *L.*

These grasses along with some others, which I could not determine, were found on the Water of Leith, near Currie, where they have been introduced with Esparto grass.

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Cryptogramme crispa, *Br.*	Hills behind Bathgate.
Botrychium Lunaria, *Sw.*	On West Craigs Hill near Bathgate.
Ophioglossum vulgare, *L.*	Near Bathgate, and South Queensferry.

11*th March* 1875.—Sir ROBERT CHRISTISON, Bart., M.D., D.C.L., President, in the Chair.

The following Communications were read:—

Bearing of Meteorological Records on a supposed change of Climate in Scotland. By ALEXANDER BUCHAN, M.A.

It is a belief very generally entertained that the climate of Scotland has undergone considerable change in recent years, the summers being less hot and the winters less severe than they used to be. This idea was ably advocated by Mr M'Nab in his presidential address to the Society in November 1873. The facts which were adduced in its support referred solely to vegetation. In this paper the question is examined exclusively from a meteorological point of view, and the examination is confined to monthly mean temperatures.

The following are the records which have been made use of:—1. Monthly mean temperatures from observations made at Gordon Castle, Banffshire, from July 1781 to November 1827; 2. The monthly temperatures given in Forbes' climate of Edinburgh (Trans. Roy. Soc. Edin. vol. xxii. p. 335); 3. Observations made at Dollar from 1836 to 1856, and from 1861 to 1874; and 4. Observations made at Elgin from 1855 to 1874. The mean temperatures of the months and the year were calculated for each of these four series of observations for the interval embraced by each, and then the differences of each month's mean temperature from the general mean for that month and station were set down in a table. Since the time over which each of these series of observations extended was sufficiently long to give a very close approximation to the true mean for the hour of observation and exposure of the thermometers, and since the means of the separate months were only compared with the

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means for that place, the table may be regarded as representing very closely the *monthly variations* which have occurred in the temperature of Scotland during the past ninety-four years. It may be noted that the observations were made in two districts, viz., Gordon Castle and Elgin in the north, and Edinburgh, Dunfermline, and Dollar in the south.

The variations of each year, and of each month of each year, were exhibited in curves, showing graphically the fluctuations which have occurred during this long period. The coldest year was 1782, being 3°·3 under the average, the deficiency of May of that year being 6°·7, and August 5°·9; then follow 1799 and 1816, being 2°·3; 1838, being 2°·0; and 1860, being 2°·4 under the average. The two warmest years were 1794 and 1846, the excess being respectively 2°·7 and 2°·9. During the nine years from 1787 to 1795, the temperature was generally above the average; the mean annual excess of the nine years being 1°·5. For the next quarter of a century temperatures were generally under the average. From this period to the present time there have occurred five fluctuations in the annual temperature above and below the average, differing in amplitude and duration, but giving no indication of any steady permanent change either way. Exceptionally warm and exceptionally cold months are distributed over the period in such a manner as to show that substantially no permanent change has taken place in the temperature of any of the months, or of the year.

Since, however, the eye may not be able easily to detect any steady rise or fall that may be going on owing to the sharply serrated character of the curves, other averages were calculated on the method of taking as the average of, say, January 1784, not the average of that year, but the average of the five years 1782, 1783, 1784, 1785, and 1786. All the averages were dealt with in this way, and the results projected in a set of thirteen new curves. From these consecutive five years' averages, it is seen that mild Decembers prevailed from 1787 to 1797, from 1822 to 1845, and from 1862 to 1867; and cold Decembers from 1798 to 1821, from 1846 to 1861, and from 1868 to the present time. It may be noted that in 1821 the remark might have been made

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from the previous forty years' observations, that the character of Christmas weather had undergone a great change, the Christmases of the latter part of the period being generally much more severe than those of the former; and again, in 1843, looking at the long period of forty-seven years, beginning with 1796, it might have been said that the old-fashioned Christmas weather had almost ceased to occur in the latter half of this long period, and that the climate had undergone some great permanent change. Now, while both would have been right as to the facts (whether these facts were based on numerical data or on recollections), both would have been wrong in inferring a permanent change, even though the inference was based on the observations of half a century. Looking, however, at the ninety-four-years' period, we can only conclude that the weather of December, as regards temperature, is subject to large fluctuations, which differ both in intensity and duration, but that there is no tendency to a permanent increase or decrease of temperature.

One of the most interesting features of the curves is the similarity existing among them *inter se*. The curves for August and September closely resemble each other, as also do those for November and December, while that for October combines the main features of the two sets. The curve for January combines the main features of the curves for November and December on the one hand and February and March on the other, and so on with the other months.

The general result of the inquiry then is, that though large annual fluctuations of temperature have occurred, yet the warm and the cold cycles, extending over longer or shorter periods, are so distributed over these long intervals as to give no indication that there has been any tendency towards a steady increase or decrease in the temperature, or that any permanent change has taken place in the climate of Scotland. And since the same remark applies with equal force to the observations of the separate months, it follows that meteorological records give no countenance to the idea of a permanent change having occurred in the climate of Scotland either as regards summer heat or winter cold. It may be added that during the past seven years the temperature of July has been above its average respec-

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tively 2°·8, 1°·7, 2°·0, 0°·2, 1°·7, 1°·0, and 1°·8, and that of December, as compared with its average + 1°·5, − 4°·2, − 5°·6, − 1°·1, − 0°·8, + 3°·4, and − 7°·4; results quite in the opposite direction of the popularly entertained belief that the summers are colder and the winters milder than formerly.

II. *Notes on the effects of the late frost on Trees and Shrubs at Carlowrie and neighbourhood.* By Robert Hutchison of Carlowrie.

The winter of 1874–75 has proved more destructive to vegetation generally in this district than any of the intervening seasons since the memorable winter of 1860–61. Various circumstances combine to render the effects of a severe frost particularly noticeable in this situation, and they are always more marked after a very wet and foggy period, such as was experienced towards the close of last year. Situated in the centre of the long flat strath through which the river Almond flows, the wide area of level land in this district is peculiarly liable to mist and fog, which envelope the young plantation grounds, and, along with the retentive nature of the soil, frequently retard the ripening of the year's growth of wood during the autumn months. Another circumstance which contributes to render frost more severely felt upon evergreens in this locality than in many others, is the fact that its altitude is only 92 feet above sea-level, and that it possesses a southern aspect, which exposes vegetation to the severe alternations of frosty nights and sunshiny days. Although the frost of last winter was scarcely so intense as that of 1860–61, when the lowest indication of the thermometer was 10° below zero, there was a considerably greater amount of wind, which always proves very destructive to evergreens and Coniferæ, inasmuch as it blows off the covering mantle of snow which protects their young wood and buds. From this cause many of the shrubs in this district have, during the past winter, suffered severely; and indeed it is hardly possible as yet to estimate the full extent of the injury which has been done by last winter's frost; for some speci-

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mens, at present very much browned in appearance, may recover. So far, however, as we can yet discover, we may state that in this locality the Laurustinus (*Viburnum Tinus*) is killed outright—a few plants only in more sheltered positions, being alive under the snow-line. The common Cherry Laurel (*Prunus Lauro-Cerasus*) is at the present date showing more signs of having suffered than it did immediately after the continuance of the frost, and has lost all last year's growth of wood. In one situation, in rather wet soil, where some two-year-old cuttings were planted, about two-thirds are completely killed.

It is a noticeable fact that the Caucasian variety of the Cherry Laurel has proved much hardier than the common, while the Colchic variety, with its handsome narrower-shaped leaves, of paler green, has suffered most of all. The common Portugal Laurel (*Prunus lusitanica*) has been very much browned, and in many places is now shedding its leaves; and some of the young wood on the more exposed portions of the plant has been killed.

Hollies, both common and variegated, have been more or less affected; and the larger specimens, about 30 feet in height, have, as was the case in 1860–61, lost many of their leaves, and still continue to shed them. It is a noticeable feature in regard to variegated hollies, that the golden varieties have suffered far more severely than the silver, and also that the parts of the leaves which are most injured are the variegated portions. At first sight it might be thought that this was merely apparent, and due to the tarnished brown colour being more visible on these than on the green parts of the leaf; on examination it will be found that this is not so, but that the variegated parts have, in reality, proved more susceptible to the influence of the frost. The variety called popularly the variegated Prickly Hedgehog (*Ilex ferox variegata*) has proved the most tender of the variegated varieties, and next to it the Golden Milkmaid (*Ilex aureo marginata*); while of the green varieties, the smooth-leaved sort, *Ilex aurea Dahoon*, has been most injured.

The common Ivy has been very much singed, and the points of its shoots are much frost-bitten. Variegated varieties have, as was noticed in regard to hollies, gener-

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ally fared the worst; one kind, the Algerian (*H. algeriensis*), has suffered more severely than any other, and, as was noticed in the case of the Colchic Laurel, it is of a delicate palish green colour; indeed, this peculiar tint of green appears to be more susceptible of injury from weather than any other; for we have instances of this in the *Pinus Pinsapo*, *P. lasiocarpa*, and other evergreens. In situations with a southern exposure the Heart-leaved Ivy (*H. Rœgneriana*) has been very much browned, and much of its young wood has been killed. Another wall-creeper, *Cratægus crenulata*, has been killed to the ground.

Wall Roses have been very severely injured, and on the open border there have been more casualties among standard and dwarf hybrid perpetual Roses than was experienced here even in the winter of 1860-61. Amongst the newer Coniferæ, the *Wellingtonia gigantea* has stood uninjured —a peculiarity of this species which we have before noticed; and it is far more likely that the Wellingtonia in this country will suffer from the effects of frosty spring winds than from the intensity of frost. The variegated Wellingtonia has suffered very severely in its golden patches of variegation which are completely killed, although the plants are otherwise uninjured; it is to be hoped that as they progress in growth they will again throw out fresh shoots here and there of delicate straw-coloured markings. *Taxodium sempervirens* has probably suffered more than any other of the newer Coniferæ. Plants of this species of from 3 to 6 feet in height, which had been transplanted to their present position last spring, although they had quite recovered from the effects of removal, and had made vigorous growths for the year, have perished outright. Other specimens, from 12 to 20 feet in height, have lost many of their outer last year's shoots.

Several specimens of *Cupressus Lawsoniana* have been much browned in the foliage; but although they may lose some of their outer fringes the plants are otherwise perfectly safe, and it is only when exposed to the sun and wind that they have been thus affected. One variety, *C. Lawsoniana amabilis*, has received so severe a check, and appears so sickly, that it is impossible at present to say whether it

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will survive or not.* *Cedrus atlantica* has been a good deal scorched on the tips of its needles, and has suffered more in this respect than either *C. Deodara* or *C. Libani.* The *Araucaria imbricata* has been a good deal browned on its young shoots, and presents the peculiar and suspicious-looking feature which many plants did in 1860-61, that of curving the points of its lateral branches downwards; and although it is yet too soon to speak definitely as to the amount of injury which this species has received, we fear that, with a recurrence of frosty easterly winds during the present and next month, many specimens of this handsome plant will be permanently disfigured.

It is a notable fact that several Araucarias which were killed down to the snow-line here in 1860–61 have suffered materially less during the past winter than others which have been planted since, though located under similar circumstances—a fact which, I think, goes to prove that as many of the more recently introduced Conifers become longer inured to the climatic changes of Britain, they will throw off any tendency to delicacy they at first evinced, and probably in future years the produce of cones grown and ripened in this country will present a vigour and robustness which their progenitors lacked. Among the other Conifers which have, more or less, been severely browned in their foliage, and which have partially lost some of their last year's growth, I may notice *Abies Douglasii*, which, where exposed to wind, has suffered severely; *Pinus monticola*, *P. grandis*, *P. Pinsapo*, *P. cephalonica*, *P. Edgariana*, *P. Jeffreyi*, and *P. Lowii* (*Parsonsii*). In some exposures *Cedrus Deodara* is slightly singed on the weather side, while the following have all escaped thoroughly unscathed: —*P. Laricio*, *P. excelsa*, *P. balsamea*, *P. Nordmanniana*, *P. Sabiniana*, *P. nobilis*, *P. cembroides*, *P. Cembra*, *Librocedrus decurrens*, *Thuja gigantea*, *Thujopsis borealis*, *Retinospora pisifera*, and *R. obtusa.* Amongst the Cupressus tribe, where again the pale green tint and foliage we have already referred to is predominant, it is noticeable that *C. Lambertiana* is in many places dead, and in others the young twigs are so severely browned that they are shed from the plant by simply passing the hand along the

* This plant has since died, Sept. 1875.

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branch. *Cupressus macrocarpa* has lost most of its young shoots, and contrasting with the fastigiate habit of this pine, the curved over affection of its lateral branches is most striking and apparent. *C. Goveniana* has lost all its last year's wood, and looks sickly throughout the whole plant.

Among other evergreens which have all suffered more or less severely, and sufficiently so to make the effects remarkable above those of any common winter, we may notice the following:—*Pernettya mucronata, Aucuba japonica, Chamæcyparis sphæroidea, Cryptomeria japonica, Jasminum officinale,* and *Clematis Vitalba.* The Nidpath Castle Yew is considerably more browned in foliage, and appears to have suffered more, than the common English Yew, or even than the Irish. *Pinus maritima, P. Albertiana, P. nobilis, P. ponderosa, P. excelsa, P. austriaca, P. Pallasiana,* appear to be all perfectly safe and untouched.

One noticeable feature upon the hard-wood trees of larger growth, owing to the severity of last winter's frost, was their splitting down the stem—a fact which was also noticed in 1860-61. Individual beech trees, of from 9 to 12 feet in circumference, which split in the winter of 1860–61 as if struck by lightning, were during last winter observed again to open up their old rents. This is a frequent occurence in Canada, where old trees, especially if very vigorous and full of sap, are reported to contract and expand, to split and go together again, season by season, with the alternations of climate. Although this is a rare occurrence in a climate like that of Britain, and may be only noticeable after winters of severe frost, such as that of last year, it was not confined to beeches alone, but oaks, limes, and the ash were observed to suffer in a similar manner. Sycamore and Plane trees of old growth have, since last winter's frost, shed in abundance the scales of their outer bark; and it was particularly noteworthy, that after the severe and sudden depression in the thermometer these bark-scales shrivelled together and became loose, so that on the first blast of wind they were displaced and fell to the ground.

From the foregoing notes it will be observed, that it is

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hardly possible at this date to give an accurate list of all the shrubs and evergreens which have either proved hardy or unable to resist the severity of such a winter as that of last year; but it is to be hoped that the list already given of such specimens as the frost appears to have seriously affected, will not require to be augmented by further experience; while, on the other hand, we trust that with a mild and genial spring, and an absence of easterly frosty winds, many of those species already reported as in a state of dubious vitality may yet recover.

It should have been stated that the lowest temperature reached during last winter was on New Year's Day morning, January 1, 1875, when it registered here 4° below zero at 4 feet from the ground. On the ground, 8° below zero was the minimum point reached.

III. *On the Absorption Spectra of Chlorophylline Chromules.* By N. Pringsheim. Communicated by J. F. Duthie, B.A.*

From a somewhat extensive series of experiments on Chlorophyll, the author has here collected some results obtained from the optical examination of those yellow chromules,† which, besides chlorophyll, or as representing it, are generally diffused throughout the leaves and flowers of plants.

The phenomena of absorption and fluorescence peculiar to these chromules are imperfectly known. Their spectra, however, show a very noteworthy agreement with that of chlorophyll. This agreement, hitherto overlooked, reveals the close affinity of these chromules to chlorophyll, and leads to rather important physiological inferences, which being only indicated here will be further carried out and established in future communications.

The author divides his subject into the following heads:—I. The yellow chromule of etiolated plants. II. The

* This paper, by permission of the Council of the Society, appeared in the "Journal of Botany" for April 1875.

† The term "chromule" is used throughout in the general sense of colouring matter.

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chromule of yellow blossoms, with appended remarks on the spectrum of the yellow chromule of autumn leaves. III. The yellow ingredient in the green leaf (chlorophyll).

The following is the substance of these investigations:—

I. *The yellow chromule of etiolated plants.*

Plants grown in the dark, more particularly Angiosperms, do not become green, and so it has been generally supposed that chlorophyll is developed under the influence of light. If, however, plants develope for some time in the dark, they do not appear colourless, but intensely yellow.

The relations between this yellow chromule and chlorophyll are not yet known; and although it may seem natural to suppose, when etiolated plants become green on exposure to the light that it is this yellow chromule which changes to chlorophyll, still no facts have yet been brought forward to warrant such a conclusion.

The optical characteristics of chlorophyll, its monochromatic fluorescence, and very peculiar spectrum of absorption easily distinguish it from other chromules. There exist however, several modifications of chlorophyll. I wish now to confine myself to those properties of the chlorophyll-spectrum which are directly involved in a comparison with the other spectra to be discussed. I refer particularly to the seven known dark bands in the chlorophyll spectrum corresponding to the regions of greater absorption; and as usual I count them as they appear in an alcoholic solution in the direction from red to violet.

It is important to notice the relative amount of absorption in the darkened regions of the several forms of chlorophyll as indicated by the order in which the bands of absorption become visible according as the amount of chlorophyll contained in the layer increases.

The spectrum given by solutions of moderate concentration of chromule shows bands I., II., III., IV., or in some cases I., II., IV., in the first or less refrangible half of the spectrum; in the second and more refrangible half a continuous absorption takes place consisting of bands V., VI., VII., joined, beginning either at F (Frauenhofer), or at varying distances before F, according to the richness of

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the layer. Layers containing extremely little chromule show only a trace of band I. at first, which becomes more sharply defined on increasing the chlorophyll matter; and with a further increase the bands of the second half—V., VI., VII.—appear; after which II. and IV., and finally III. become visible.

Various conditions may interfere with the above order of appearance of these bands, such as—slight chemical changes in the chromule; the influence of more than one solvent; the varying intensity of transmitted light, &c. Nevertheless it may be taken as a general rule that bands V., VI., VII., in the blue, also bands II. and IV., observe with regard to I. and III. the order of succession as stated above; and we may consider the invariable predominance of band I. as the characteristic mark of all *green* chlorophyll. It is also the most persistent band of those of the first half.

It has always been supposed that the 7-banded spectrum here described belonged exclusively to the green chlorophyll of leaves, and could thus be distinguished from all other chromules, including that of etiolated plants, which latter was believed to have absorptions only in the blue region. Both Askenasy and Kraus held this opinion. A closer examination shows, however, that the chromule of etiolated leaves, which the author proposes to call Etiolin, gives a spectrum nearly identical with that of chlorophyll, only differing as to the *amount* of absorption in the places corresponding to the chlorophyll bands. This correspondence between etiolin and chlorophyll may be observed by using a more concentrated solution of the former.

The etiolin solutions were obtained from various plants which had germinated in the dark, until the cotyledons had appeared and developed. Even with moderately thick layers, generally before the three bands in the blue have united into a continuous absorption band, the chlorophyll band I. is seen in its right place, very distinctly defined. Further, when the illuminated layers increase in thickness, bands II. and IV. gradually show themselves, and when sufficiently concentrated, band III. also appears.

It is an important fact that this spectrum of etiolin possesses all the seven bands of the chlorophyll spectrum;

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and that bands I., II., III., IV., lie exactly in the same places as in the case of chlorophyll; whereas bands V., VI., VII., appear somewhat displaced and nearer to the red. A further difference is, that if the solution be thick enough, band II. invariably appears split. These differences, however, are of minor significance, seeing that similar variations may be produced in any chlorophyll solution under certain definite conditions. We are thus justified in considering etiolin merely as a slight modification of chlorophyll produced under different physiological conditions. Etiolin also shows the same red monochromatic fluorescence peculiar to chlorophyll.

It might, perhaps, be assumed that in etiolated plants there exist two substances, viz., a yellow one without absorption in the first half of the spectrum being present in larger quantity, and the normal green chlorophyll in a less degree, according to which view chlorophyll would be produced without the agency of light. There are no facts to support this theory, however, and it seems much more probable that etiolin is an unmixed substance, being a yellow modification of chlorophyll. For we have never been able to separate etiolin into green and yellow components, as in the case of chlorophyll.

According to this view, therefore, concerning the relation between etiolin and chlorophyll, the proposition respecting the influence of light requires qualifying, by saying, that while the formation of chlorophyll in general is independent of light, it is a yellow form of chlorophyll that is produced in the dark, but a green modification in the light.

II. *The chromule of yellow blossoms.*

The changes in colour which the parts of yellow blossoms and fruits undergo during their development, point to a close connection with the chromule of chlorophyll.

Its optical properties differ only in having weaker absorptions in the first part of the spectrum. Kraus seems to have been the only one who has subjected the chromules of yellow blossoms to spectrum analysis. From not using layers sufficiently rich in chromule he failed to detect the

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chlorophyll bands of the first half of the spectrum, just as he had done in the case of etiolin.

This weakening of some of the chlorophyll characteristics varies in different flowers. The strength of the bands, however, seems to remain constant in plants of the same Natural Order. In some of the examples which showed the weakest absorptive power, such as a kind of yellow rose, *Carthamus tinctorius*, and various yellow Dahlias, even with concentrated layers 370mm. in thickness, there was scarcely a trace of band I. to be seen. The yellow chromules of blossoms accordingly form a continuous series of gradations of chlorophyll. Even those which differ most betray their genetic connection by presenting similar absorption bands in the blue.

In this anthoxanthin series the red fluorescence is more or less apparent in proportion to the strength of the chlorophylline absorption phenomena.

There is a further important fact, viz., that in proportion as the peculiar optical characteristics of chlorophyll vanish, the solubility of the anthoxanthin in water increases. This fact obviously throws light on the nature and origin of the yellow chromules soluble in water which occur associated with chlorophyll in the green parts of plants and which finally lose even the last spectrum marks of chlorophyll.

Special precautions were taken to select for anthoxanthin examinations examples entirely free from any accidental admixture of green chlorophylline particles. The optical qualities of anthoxanthin cannot be inferred from the forms of these particles. They most frequently occur as very minute, round or oval, elongated, pointed, or spindle-shaped corpuscules; sometimes solid and sometimes hollow. Frequently it pervades a protoplasm entirely amorphous, and in rarer cases the material basis exhibits the more definite forms belonging to true chlorophyll globules.

Sometimes yellow-coloured drops occur in the cells, the chromules being dissolved in an oleaginous substance, whilst cases have been observed, but rarely, where the entire cell was filled with this liquid. In some examples of this the author remarks how the liquid frequently shows a

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changing hue, so as to make it doubtful sometimes whether the cell is filled by a yellow or a green liquid.

The optical qualities of this chromule in regard to its greater or less approach to green chlorophyll is by no means in proportion to the form of its basis. The chemical changes which the chromule itself suffers, cannot, however, on the whole, be very considerable, seeing how slightly their optical characteristics vary. It might be assumed that this close optical correspondence arose from the presence of unchanged chlorophyll in the yellow blossoms employed. This, however, cannot in any way be anatomically demonstrated, and it is impossible, after the manner of the attempted separation of chlorophyll, to separate the anthoxanthin (possessing chlorophylline properties) into a green chlorophyll element, and a yellow element without the characteristic optical marks of chlorophyll.

On the spectrum of the yellow chromule of autumn leaves.

In the examination of these leaves my object was to test whether any chlorophylline chromule could be found which did not exhibit the first four bands of the chlorophyll spectrum. Here certainly the possibility of an admixture with chlorophyll might be much sooner suspected than in the case of anthoxanthin; and accordingly perhaps less value may be attached to the circumstance that in yellow autumn leaves I have likewise failed to discover any purely yellow chromule without chlorophyll band in the red. These bands, however, are not nearly so clearly seen as in the case of anthoxanthin and etiolin: a result hardly to have been expected on the supposition of the chromule of autumn leaves containing any possible admixture of chlorophyll.

The author then gives the results of some experiments with the alcoholic solutions made from faded oleander leaves and old rye straw, from which he concludes that their chromules possess the properties of chlorophyll but only in a slight degree, only band I. having been as yet seen, to show its origin from chlorophyll.

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III.—*The yellow ingredient in the green leaf (chlorophyll).*

Since Fremy succeeded in separating an alcoholic solution of chlorophyll into a yellow and blue component by means of muriatic acid and ether, the view of the older botanists with regard to its green colour depending on its containing two substances, has to some extent been verified. It was, however, very soon demonstrated that acids and alkalies have the power of changing the constitution of chlorophyll, for it was proved that at least one of the two chromules obtained by Fremy, viz., that taken up by the muriatic acid, is not an original constituent of chlorophyll, but a result of its disintegration. A better method of separating the component parts of chlorophyll has since been made known, viz., that of using two non-miscible solvents, generally a normal green alcoholic solution of chlorophyll, whilst the other solvent should be one that will not chemically unite with alcohol, such as benzol, carbon, disulphide, or some fatty or ethereal oil. The liquids are intimately mixed by shaking. After separation the alcohol of the original solution will no longer appear green, but more or less yellow, whilst the other solvent will show a grass-green or glaucous colour. Those two chromules are looked upon as the pure components of leaf-green. The yellow portion dissolved in the alcohol does not possess the optical marks of chlorophyll, whilst the glaucous component, though supposed to possess the essential characteristics of chlorophyll, is still believed to distinguish itself from the original solution.

The opinion that chlorophyll is a compound, its colour being due to the two constituent elements, has received important support, and indeed seemed completely confirmed by the yet unrefuted assertion of Kraus, that the absorptions of the two components are combined in the chlorophyll spectrum. Kraus also affirms that the yellow component has absorptions only in the blue, and the green or glaucous component in both halves of the spectrum, which is undeniable; yet those in the second half are obviously displaced. He believes that the first four bands in the chlorophyll spectrum are entirely due to the glaucous component, and that the continuous absorption shown by

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unseparated chlorophyll is simply a combination of the somewhat differently situated bands of the two components. These assertions, however, require considerable correction.

Certain conditions are necessary for the proper observation of these phenomena. The first to be mentioned is that the added solvent must not be perfectly miscible with the alcohol of the chlorophyll solution, which depends on the dilution of the alcohol. Thus, *e.g.*, benzol mixes freely with alcohol of 90 per cent. strength. With weaker alcohol the phenomenon always presents itself, but its distinctness depends on the degree of dilution of the alcohol, on the relative proportions of alcohol and benzol, and also whether more or less benzol is retained in solution by the alcohol. A certain amount of dilution of the alcohol is an advantage therefore by keeping the alcohol and benzol portions as separate as possible; too much water, on the other hand, is apt to produce turbidity on the addition of the benzol.

As to the colours which make their appearance, it is important to remember that benzol, carbon disulphide, various fatty and ethereal oils, certain acids, &c., are able to absorb many times more chlorophyll than even high-percentaged alcohol, and are accordingly tinged much more deeply.

The disregard of these conditions has given rise to much dispute as to the proper *colour* of the green component.

The yellow colour of the alcoholic portion is also influenced, but in a reverse manner, of course. As already remarked, the yellow alcoholic portion of chlorophyll is believed to have absorptions only in the second half of the spectrum, but a closer examination reveals also the characteristic chlorophyll bands in the first half. In a few cases Kraus appears to have noticed a trace of the chlorophyll band I., from which he inferred that the chlorophyll had not been completely eliminated from the yellow chromule. But we have never succeeded in obtaining a yellow alcoholic portion which had no chlorophyll bands in the first half. When the chromule is abundant it is not difficult to produce the entire chlorophyll spectrum.

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It is an important fact too, that band I. is visible longer than the bands in the blue. This affords a proof that the chromule retained by the alcohol consists at least in part of normal green chlorophyll matter. Which of the yellow chlorophyll chromules may in addition be also present in the leaf-green—whether etiolin, zanthophyll, or both—can scarcely as yet be determined by spectrum analysis.

Kraus' statement regarding the glaucous, or grass-green, ingredient is certainly correct. The conclusion which he draws from this is, however, not admissible; for he supposes that the relatively displaced bands in the blue reveal a special component which he calls Kyanophyll, and that bands V., VI., VII., as situated in kyanophyll, together with the similar bands of the yellow alcoholic portion, combine to form the terminal absorption of the normal chlorophyll spectrum. The spectrum from chlorophyll solutions of medium thickness might possibly be thus explained; but in weaker solutions the three bands of kyanophyll do not present themselves, whereas in equally diluted solutions of kyanophyll they come out distinctly. Apart from this, however, this view is already refuted by the fact that the altered position of bands V., VI., VII., depends on the solvent.

Kraus was aware of the influence of the solvents, and thought that the displacement of the bands depended on their specific gravity; but Kundt shows that it depends on their dispersive power. I have found that some solvents of chlorophyll not only cause displacements of the bands, but also remarkable changes in the breadth and intensity of the bands. This would indicate, at least with regard to chlorophyll, that these solvents have even a chemical influence on the chromule.

The author next proceeds to a description of the peculiarities presented by the spectrum of a solution of chlorophyll in benzol, in which the displacement of bands I., V., VI., and VII., are easily observed, and in addition to this a splitting of band I. first into two and then into three bands is very distinctly to be seen when medium thicknesses of chromule are used. A similar splitting of band I. has already been observed by Schöm, Gerland, and Rauwenhoff in ethereal solutions of chlorophyll, and this splitting of

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band I. may under favourable circumstances be noticed also even in alcoholic solutions. Turpentine chlorophyll also shows this splitting.

The situation of the bands characteristic of benzole chlorophyll, of course comes out also in the benzole portion of separated chlorophyll, and constitutes in fact the displacement of the bands in the blue, which Kraus saw and described quite correctly; but his assumed composition of the chlorophyll spectrum cannot be inferred from this, simply because the bands of his kyanophyll are not present at all in unseparated alcohol-chlorophyll. A further study of these alcoholic and benzole portions will occasionally reveal slight deviations in the respective situations of the bands as described by me. These may very easily be explained if we only bear in mind that in most cases of separation we do not obtain pure solutions of chlorophyll in this or that solvent, but in a mixture of solvents. By judiciously regulating the relative proportions of the solvents, we may sometimes succeed in producing the observed medium.

Conclusion.

In order to define more accurately my views concerning these chlorophylline chromules, I will now compare the distinguishing characteristics of the various groups, and add a few remarks on the diverging views of other physiologists.

In the course of his recapitulation the author, after alluding to the varying degrees of solubility in alcohol and in water, presented by the anthoxanthin group, remarks that in addition to these we very generally meet with other yellow chromules often associated with the cell-walls of plants which do not even possess the three chlorophyll bands in the blue, but in their place an absorption beginning from the violet end and spreading continuously over the spectrum. This absorption might possibly be conceived as an intensification of the chlorophyll band VII., in which case these chromules would have to be regarded as the last members in the chlorophylline series.

It must now appear evident why I could not agree with Fremy, Filhol, or Kraus in their descriptions of the green and yellow chromules, and still less with Sorby respecting the

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several chromules which he alleges to have obtained from various plants, and which he regards as distinct and undecomposed substances pre-existing in the plants and capable of definite analysis.

It is certain that many of these chromules must have been deprived of their original spectrum characteristics by the treatment to which they were subjected. In the determination of the spectra, moreover, the influence of the solvents, that of concentration, and of the thickness of layers, seem to have been equally disregarded. It is clear that a single spectrum can give us no adequate information as to the absorption phenomena of any chromule, unless we are acquainted beforehand with its phases of absorption, and know to which phase of the bands it corresponds. Sorby has nowhere stated, with reference to his yellow chromules, to which he ascribes two separate bands in the blue, to what extent the various positions of the bands are influenced by the solvents, nor how they depend on the thickness of the layers; nor does he state, that with an increase of the chromule additional bands do not appear. I doubt not that the whole, perhaps, of his yellow chromules —one only excepted, would suddenly reveal also the chlorophyll bands of the first half, if my method were applied.

If in future more accurate distinctions are attempted to be drawn, it will be necessary in every case to demonstrate carefully to what extent the observed difference in the spectra might or might not be explained by the solvents employed, or whether they do not depend on some cellular contents of the plants examined; and finally, it would have to be shown that they are more than particular phases of the same absorption bands.

[Abstract of paper in the "Monatsbericht" of the Royal Academy of Berlin, October, 1874.]

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IV. *On Injury done to Drains by Roots of Trees.* By Thomas Greig, of Glencarse.

The subject which I bring before the Society, is one of geat importance, deserving careful consideration. Since the introduction of tiles and pipes for draining purposes, the annoyance both to landlord and tenant is beyond what can be well imagined; for when drains have been carefully and efficiently laid at great expense, the roots of trees creeping stealthily under ground proceed towards the drains, and entering the pipes by a small rootlet, increase in a short time to a mass of roots, which entirely choke the pipes, and stop the flow of the drains, leaving those not unconcerned onlookers sadly puzzled to account for the stoppage of the water.

In several instances I have had costly experience of pipes being choked by rootlets.

1. In conveying water from the fountain-head through an orchard to my entrance lodge, I laid a 2-inch pipe with sockets, but in two years the supply of water ceased; the pipes not being beyond 1 foot deep in the ground, the water rose to the surface where the stoppage occurred, and the green colour of the grass at once shewed where the drain should be opened, when we found the pipes filled with rootlets from the apple trees. I may add this frequently happens, but the mischief, being soon discovered, is easily rectified.

2. The lead pipe supplying water to the Mansion House from the fountain-head ceased to do so; and, thinking that a frog had got into the pipe, I had it uncovered and cut into 10-yard lengths. The third cutting revealed the cause —not a frog, but a bunch of rootlets, extending for a considerable distance inside the pipe, proceeding from a small fibrous rootlet that had entered the pipe by an almost invisible crack.

3. Having laid a leading drain upwards of 1100 yards in length with 8-inch pipes for a considerable portion of the distance, following with 6 inches and 4 inches as they proceeded with the drain, also laying a number of side drains into it, which brought off a large supply of water from a considerable area of flat land, at the end of two years I was

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surprised to find that no water issued from the pipes, but remained on the surface of the land. I sent for the person who had executed the work, and, on receiving his assurance that he had himself put in the pipes most carefully and superintended his men filling in the drains, so that he felt confident none of the pipes could be disturbed, we came to the conclusion that the roots of the willows must be the cause; and on digging down to the pipes, we found them completely choked by rootlets, so hard pressed together that it was with difficulty they could be removed. What appears remarkably strange is that the willows had been planted within 2 yards of a dam, and had grown there for at least fifty years. They sent their roots to a distance of 20 to 25 feet under the cart road, and entered the pipes at the depth of 7 feet from the surface. I had no alternative but to cut down this row of tall, handsome willow trees, which were greatly admired by visitors to the glen. Had I used spigot and faucit pipes, having them well cemented at the joints, this might have been prevented, but the distance of the drain from the trees did not lead me to suspect danger. Eight or ten weeks ago, I observed water again lodging on the surface of the land. I went to the outlet of the drain and found little or no water issuing from it; and although I had cut down the willow trees adjacent, the bark was not removed from the trunk, consequently twigs soon grew and had a connection with the roots. I immediately set men to open the drain, and on getting to the pipes found them filled with rootlets. I believe that the aim of the rootlets is to support themselves, and not to convey nutriment to the parent tree, for there is not sufficient passage for the sap to rise.

Not expecting to visit Perthshire before this paper was read I wrote to Mr J. Ritchie, C.E., Perth, who set out the drain, for certain particulars as to length, depth, &c. He remarks: "The willows, having abundance of water in the dam alongside which they were growing, I certainly never anticipated their rootlets going through under the public road to the drain on the north side of it. Curiously enough, I have been to-day examining some large drainage outfalls, laid with 12-inch pipes, on one of the Kilgraston farms called Oudenard, which are choked with tree-roots, oak and birch

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chiefly, and the drainage water the roots get in the pipes is quite bitter from mineral water in the soil, not much weaker than the Pitkeathly water." He adds, "I have seen Mr W. S. Macdonald, of Craigielaw, Drem, formerly factor for Sir J. Heron Maxwell, of Springkell, who tells me that he had a 2-feet square stone-covered drain at Springkell completely choked up by roots from one ash tree."

8th April 1875.—Sir ROBERT CHRISTISON, Bart., in the Chair.

The following Communications were read:—

I. *Notes on the Discomycetes of the Edinburgh University Herbarium at the Royal Botanic Garden.* By M. C. COOKE, M.A., LL.D.

By permission of Professor Balfour I have been enabled to examine this portion of the Herbarium more closely than when I arranged the fungi some time ago. Having of late had occasion to apply myself more specially to the Discomycetes, I proffered a few critical notes on the specimens contained in the Edinburgh Herbarium, which would receive illustration from recent experience. This collection is interesting from the fact that it includes a set of the "*Scleromycetes Suecicæ*" published by Fries, in addition to some specimens named by the late Dr Greville, and by Klotsch, as well as contributions from more recent mycologists. Here and there a specimen derived from Schweinitz or from Dr Mougeot, adds to the interest and value of the collection.

In such observations as I make, it will be convenient that I should do so under the genera and sub-genera in the order of their arrangement, which is practically that of Fries. Day by day do I become more and more convinced that the system so much in vogue amongst certain continental mycologists of splitting up large and very natural genera, such as those of *Peziza* and *Sphæria*, into a host of smaller ones, without regard to external characters,

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on the basis of the fructification alone, is highly prejudicial to the interests of science, and calculated in the end to produce great confusion. On the other hand, I have become more convinced that, in its main features, the Friesian system is the best which has yet been proposed. With these views, I deem no apology necessary for following an order which some may consider antiquated.

No special remark is necessary on any of the genera preceding *Geoglossum*, but as this has been considered by some rather unsatisfactory as to the limits of the species comprised within it, more special attention has been given to it. The result has been considerably to augment the number of good species, and, it is believed, to facilitate the discrimination of all. This has been accomplished by a careful comparison of the fructification, and especially of the paraphyses. There is so close a similarity in the external features of some of the black species that no accurate determination can be made without an examination of the fruit. For a long time only one hirsute species has been known (*G. hirsutum*, P.) The sporidia in this species are very long (0·15 mm.) and 15 septate, the paraphyses septate, scarcely thickened, but curved at the apices. The hairs originate from the base of the hymenium, are rigid, dense, and almost opaque, so that it is impossible to overlook them in the examination of the fruit of this species. It would be quite unnecessary to regard the septation or size of the sporidia were this, as hitherto supposed, the only hirsute species. By the kindness of the Rev. M. J. Berkeley, I have recently examined a much smaller species (*G. Walteri*, B.) from Australia, in which the hairs are somewhat more delicate, the paraphyses very similar, curved at their summit in a like manner, but the sporidia are much smaller (0·1 mm.), and only 7 septate. Two or three years since a North American species (*G. simile*, Peck) was described, apparently in error; for an examination of authentic specimens from Mr Peck himself has convinced me not only that it is a perfectly smooth species, but also that it is identical with *G. glabrum*, P. A third, but still smaller, hirsute form has lately been submitted to me, which may prove distinct.*

* Since determined to be only an interesting variety of *G. hirsutum*, with the clubs nearly smooth or the hairs but slightly longer than the asci.

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The two hirsute species are therefore readily distinguishable from each other by the number of septa in the sporidia, and from the rest by the rigid hairs of the hymenium. The smooth species have some of them brown, and others colourless, sporidia. Those with brown sporidia found in Britain are *G. glabrum*, *difforme*, *viscosum*, and *glutinosum*. In *G. viscosum* the paraphyses are without septa, with a subglobose or pyriform head, in the other three species they are septate. In *G. difforme* the paraphyses are very long and flexuous, attenuated rather than thickened at the extremities, becoming almost colourless at the lips. In *G. glabrum* the ultimate four joints are elliptical, easily separating, the terminal one being the largest. In *G. glutinosum* the paraphyses are scarcely septate, but the head is clavate and not subglobose as in *G. viscosum*. The sporidia in *G. glabrum* and *G. difforme* are 7-septate, and in *G. viscosum* and *G. glutinosum* 3-septate, but the average size of the sporidia aid still further in their determination.

Septa.				
7	*G. glabrum*.....	08·09 mm. long....	paraphyses	moniliform.
	G. difforme.....	0·11 mm. long....	„	flexuous.
3	*G. viscosum*.....	08·095 mm. long....	„	subglobose
	G. glutinosum...	07·075 mm. long....	„	clavate.

In *G. viride* and *G. olivaceum* the sporidia are colourless (as also, I believe, in *G. atropurpureum*, which I have never seen), but differ in size. The paraphyses are less highly developed. It needs scarcely to be remarked that the individual specimens in the Herbarium have not been microscopically examined to ascertain how far they may have been accurately determined. To have done so with nearly 100 specimens, each of which required some hours softening in water, would have occupied considerable time, and with these remarks recorded, would hardly be essential. It may, however, not be out of place to allude to the remaining species which are not recorded as British. Two species *G. farinaceum* and *G. rufum* are described by Schweinitz as inhabiting the United States, but these I have never seen. Two additional species with colourless sporidia are found in North America, *i.e.*, *G. microsporum*, C. & P., with 7 very delicate septa, when fully matured, and a tawny-yellowish species, *G. luteum*, Peck, with 5 septa. There also a smooth

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black species with coloured sporidia, of 15 septa, for some time confounded with *G. glutinosum*, now bears the name of *G. Peckianum*, C. In Australia (probably) a black species with coloured paraphyses and colourless sporidia, without septa, is represented by a specimen (ex herb. Hooker) not localised, which has been named *G. Hookeri*, C. Two other species with coloured sporidia and paraphyses, the latter closely connate, have been found, one *G. australe*, C., in Australia, the other, *G. Mulleri*, B., in Tasmania. In the former the sporidia (0·12 mm. long) are 7-septate, and in the latter (06·07 mm. long) for some time uniseptate and at length triseptate. The sporidia in the latter are shorter than in any other species with coloured sporidia. Of the 17 species 2 are hirsute and 15 smooth; of the latter 7 have coloured sporidia and 6 (perhaps 8) colourless sporidia. Of the whole, 8 species are European, 5 North American, and 4 Australasian. Two at least of the European species are almost cosmopolitan, *i.e.*, *G. glabrum* and *G. hirsutum*, whilst the third hirsute form already alluded to—from the United States—is closely allied to, if not identical with, *Geoglossum hirsutum*. Other European species extend into North America.

Passing over the other genera with the intimation that specimens of *Leotia circinans*, recently found in Scotland (for the first time in the British Isles), have been added to the Herbarium, we come to the large genus *Peziza*.

In MACROPODES the *P. melaena*, Fr., is represented by three specimens under the name of *P. Vogesiaca*, P., from Dr Mougeot. Fries admits ("Sys. Myc." ii. p. 60) that this is the same species. The asci are cylindrical, and the sporidia globose (·015 mm. diam.), the paraphyses are thickened above and brown ("Grevillea," iii. fig. 10). *Peziza tuberosa*, Bull., hitherto included under this section, is removed by some recent authorities to *Hymenoscypha* into proximity with *Peziza firma*, P., and in this change I am disposed to concur.

COCHLEATÆ.—The specimens marked "Mougeot, 1824," and named "*Peziza chrysoclaris*, Pers. in litt.," clearly belong to *Peziza fulgens*, P., with minute globose sporidia not exceeding ·005 mm. in diameter ("Grevillea," iii. fig 26).

CUPULARES.—The single specimen named "*Peziza crenata*,

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P." from Persoon himself, is *Peziza cupularis*, Linn., of which *P. crenata*, Pers., is cited by Fries ("Sys. Myc." ii. 62) as a synonym. The sporidia are elliptical (·002 × ·012 mm.), and are identical with the fruit of the specimens published by Fuckel ("Grevillea," iii. fig. 40).

HUMARIA.—The red species under this section are so similar in external appearance that it is not surprising to find them named inaccurately in old specimens which date previous to the recognition of the fruit as an important guide to the discrimination of species. In this collection *P. leucoloma*, P., is the one species to which different plants are ascribed. The specimens published by C. E. Broome, in Cooke's "Fungi Britannici," No. 229, are *Peziza Crouani*, C. The specimen on wood marked "N. America, Schweinitz," is almost beyond identification. It belongs, however, to the section *Mollisia*, has small sausage-shaped sporidia, and probably is either *P. vinosa* or *P. rubella*, for the sporidia in both are nearly alike in form and size. The specimens from Mougeot, 1824, named "*Peziza leucoloma*, Persoon in litt.," are not identical with what is regarded as the true *Peziza leucoloma*. The form and appearance is that of the figures in Rabenhorst's "Mycologia Europœa," plate iv. fig. 3, and called on the plate, *Peziza Polytrichi*, but in the letterpress, *Peziza vivida*. The stem-like base is longer than the diameter of the cup, the asci are cylindrical, sporidia elliptic, ·025 × ·012 mm., epispore granulated, and thus agrees with the *Peziza vivida*, Nyl. ("Obs. Pez. Fenn." p. 22); also is it identical with the specimens cited by Nylander and published in Rabenhorst's "Herb. Myc." No. 310. Hence I conclude it to be the *Peziza vivida*, Nyl., which he says has sporidia ·018–·025 × ·011–·012 mm. The specimen by Dr Arnott in the Herbarium is too poor to be worth examining, as nothing would be left. The specimens No. 1, Glenshiel, 1821, appears to be the same *P. vivida*, Nyl., No. 2, small forms of *Peziza aurantia*. If none of these are *Peziza leucoloma*, P., the question very naturally arises, What is that species? If the specimens above cited were really derived from Persoon, it might be affirmed that at least they were regarded by him as identical with *P. leucoloma*, but it is probable that they were collected by Dr Mougeot, and by him were designated

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by Persoon's manuscript name. It is not impossible that Persoon himself may have confounded two or more species together under one specific name. Comparison of the figures published in "Grevillea," vol. iii., will show the difference of fruit in the two species, fig. 80, *P. vivida*, the sporidia are granulated ·025 × ·012 mm. (from Rabh. "Fung. Eur." 310) and fig. 73, smooth and nucleate, ·02 × ·01 mm. (from Fckl. "Fungi. Rhen." No. 1219). It is clear that the specimens published by Fuckel are near, and probably identical with the species determined by Berkeley and Broome ("Ann. Nat. Hist." No. 1156*), who took considerable pains to clear up the difficulties in identification of the red species of *Humaria*. According to them *P. leucoloma* has elliptic uninucleated sporidia, ·015–·02 × ·01 mm., whilst Fuckel describes his *P. leucoloma*, P. as having sporidia which are uninucleate ·02 × ·012 mm. The specimens published by Fuckel, from which the figure in "Grevillea" (iii. fig. 73) is drawn, measure ·02 × ·01 mm. All these measurements agree sufficiently to indicate the same species, which is accepted here as the true *P. leucoloma*, P.

What then is the species which Karsten and Nylander have in view as *P. leucoloma?* They both agree in indicating the same plant, published in Karsten's "Fungi Fennicæ," No. 537, and described in "Flor. Fennica" (part i. p. 63) as sessile, with a fimbriate margin, with sphæroid sporidia ·009–·013 × ·008–·001 mm. The *Peziza leucoloma* of Rabenhorst's "Mycologia Europœa," with globose sporidia ·011–·013 is probably the same thing. In both instances the sporidia are described as smooth. It is most probable that *Peziza Polytrichi*, Schum. is the species so described by Karsten and Rabenhorst as having smooth sphæroid sporidia, since the *P. Polytrichi* of Karsten and Nylander has rough sporidia, and is clearly identical with *Peziza Crouani*, C. (*Ascobolus Crouani*, Cooke, which, however, is not a good *Ascobolus*) and *Lamprospora miniata*, De Notaris. It may be remarked that the fibrillose nature of the external cells of the cup in *Peziza vivida*, Nyl., is very distinctive. *Peziza Crouani*, Cooke, included under *Ascobolus* in the "Handbook," must be transferred to *Humaria*.

Encœlia is so manifestly an aberrant section of *Peziza* in its coriaceous substance that I should follow Fries

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("Summa Veg. Scan." p. 362), and transfer *Peziza fascicularis*, Fr., and *Peziza furfuracea*, Fr., to the genus *Dermatea*.

Sarcoscypha.—Recently I have examined a fresh specimen of *Peziza coccinea*, Jacq., which had the disc of a delicate cream colour. In other respects it did not differ in the least from the crimson form in company with which it was growing. *Peziza lanuginosa* is the only example which the Herbarium contains of a most singular group of *Pezizæ* which have a sort of semi-subterranean habit, mostly of dull colours, externally more or less densely woolly, and so habitually gritty from the particles of sand, which are closely interwoven with the woolly coat, that it is difficult to wash a fragment sufficiently clean to examine the structure properly by the microscope. The species which constitute this group are *Peziza lanuginosa*, Bull; *P. sepulta*, Fries; *P. geaster*, B. and Br.; *P. arenaria*, Osb.; *P. arenicola*, Lev.; *P. arenosa*, Fckl.; and allied to them, but less disposed to be hypogeous are *P. hemispherica.*, Wigg.; *P. pellita*, C. and P.; *P. tenuis*, Fckl.; *P. flavo-virens*, Fckl.; *P. phœoloma*, Walr.; *P. macrochœta*, Fries; *P. Plumieri*, Fries; *P. fusicarpa*, Gerard; and *P. nigrella*, P.

The red species of *Sarcoscypha* are very numerous, and like the red species of *Humaria*, present many difficulties; none of these are more tedious than the attempt to clear away the mistakes which have been associated with *Peziza hirta*, Sch., and *P. scutellata*, Linn. The specimens in the Herbarium from Kritschmar, named *P. setosa*, are undoubtedly a form of *P. scutellata* (see "Grevillea," iii. figs. 113, 114). The somewhat rough sporidia are ·025 × ·015 mm. whereas the smooth sporidia of the *Peziza setosa*, Nees, as published by Fuckel, are ·02 × ·01, the cups are less open, and there is a difference in the external hairs.

The specimen named by Klotsch, *P. stercorea*, is clearly a mistake, it being *P. granulata*. The supposed variety of *P. theleboloides* published in "Fungi Britt." No. 572, is clearly entitled to the rank of a distinct species under the name of *Peziza rubra*, C., a name which has for some time been given to it (see "Grevillea," iii. figs. 118, 119). The cups are dull red, and *not* yellow, the hairs are brown and *not* white, they are also coarser, the sporidia are larger, and the cups are smaller. Although growing together, the two

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species are quite distinct. Closely allied is the beautiful yellow species found on the ground amongst nettles, in the woods at Dalmeny, N.B., during the visit of the British Association to Edinburgh. It has much the size and appearance of *P. theleboloides*, but the hairs are five or six times as long, and there is a manifest difference in the fruit ("Grevillea," iii. fig. 21). This *Peziza Dalmeniensis*, Cooke, has been found nowhere else at present, and a specimen has been added to the Herbarium. The specimens of *Peziza vitellina*, P., from Dr Mougeot, are undoubtedly reliable (see "Grevillea," iii. fig. 110). It is probably not anywhere common.

Dasyscypha.—In this section again we encounter a group of species which have been somewhat confounded in *Peziza calycina*, Sch., and its allies. The ordinary form, which is usually regarded as *P. calycina*, Sch., is represented in the Herbarium by specimens published in "Fungi Britannici," as well as others. The sporidia are elongated elliptical, or rather oblong, measuring ·02–·023 × ·009–·01 mm. This is generally recognised as the true *P. calycina*, with which the specimens published in Rehm's "Ascomyceten," and Fuckel's "Fungi Rhenani" agree. The fruit is figured in "Grevillea" (iii. fig. 166). The late A. Jerdon called my attention to a form of this species, as he supposed, which was found on *Abies*, and referred to the variety *β abietis*. On examination it was found that although externally undistinguishable from *P. calycina*, it was quite different in fruit. The sporidia are minute, sausage-shaped, not more than ·009–·01 mm. long, and about ·003 mm. broad. This is clearly sufficient grounds for regarding it as a distinct species, under the name of *Peziza subtilissima* ("Grevillea," iii. fig. 167). Karsten gives nearly the same measurements for the sporidia of *P. calycina*, as those last named, and cites *Peziza bicolor*, Bull, as a synonym. He evidently has confounded *P. subtilissima* with *P. calycina*. In nearly every collection which I have examined since this discovery, I have found both species under the name of *P. calycina*, including the Edinburgh Herbarium, where I was surprised to find that Fries had fallen into the same error, through not appealing to the microscope, by publishing in the "Scleromycetes

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Suecicæ," No. 360, a specimen of *P. subtilissima*. The specimen from Mougeot, 1824, is the same thing, as also that from the late Sir Wm. Jardine, under the name of *Peziza pulchella*.

The question to be determined is, which is the true *P. calycina*, Schum. Messrs Berkeley and Broome consider the species with large sporidia, to which the specimens in Berkeley's "British Fungi" belong, to be the genuine original species. On the other hand is the strong evidence afforded by Fries's "Scleromycetes Suecicæ," and Dr Mougeot, in favour of the species with small sporidia. One of them must be wrong, and if it can be shown that what I call *P. subtilissima* is really *P. calycina*, then the large-spored species might assume the name of *P. pulchella*, which has been regarded as a synonym of *P. calycina*. At any rate here are two distinct species, which no one can doubt who will submit them to examination.

P. subtilissima, Cooke, sporidia, linear, ·009–·01 × ·003 mm.

P. calycina, Schum., sporidia oval, ·02–·023 × ·01 mm.

The sporidia varies considerably within certain limits in *P. calycina*. In a form found growing on larch by Sir C. Trevelyan, the sporidia are sometimes as much as ·03–·035 × ·009, somewhat larger at one end, so as to have a clavate form, and the endochrome divided so that the sporidia have the appearance of being uniseptate. I have contented myself with calling this *P. calycina* var. *Trevelyani*, until the examination of additional specimens shall give me any stronger reasons than I now have for regarding the difference as of specific value. It may be remarked here that *Peziza lachnoderma*, B.; *P. illota*, B. and Br.; *P. simillima*, B. and Br.; *P. rhaphidophora*, B. and C.; *P. Agassizii*, B. and C.; and *P. chrysophthalma*, P. are all exotic species, very much like *P. calycina* and *P. subtilissima* externally, but are widely different in their fruit, as will be seen by reference to the figures published in the 3d volume of "Grevillea."

The specimens published in "Fungi Britannici," No. 275, as *P. albo-testacea*, Desm., do not belong to that species, but to *Cyphella capula*, Fr. (see "Handbook," p. 328, where this is in fact acknowledged). *Peziza albo-violascens*, P., in like

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manner, is *Cyphella Curreyi*, B., in all collections, and *Peziza villosa*, P., and *Peziza punctiformis*, Fr., are also species of *Cyphella*. *Peziza anomala*, P., is *Solenia ochracea*, Fr. None of these species have fruit contained in asci, to which might be added *Peziza millepunctata*, Lib., and *Peziza syringea*, Wallr.

Tapesia.—All the specimens published of *Peziza pruinata*, Schwz., consist of a Lichen = *Arthonia confluens*, as determined by the Rev. M. J. Berkeley. The specimens of *Peziza Wauchii*, Grev. (Grev. "Crypt. Flor." t. 139), in the Herbarium, collected by Captain Wauch, and named by Greville, at once determine the question as to the identity of that species with *Peziza aurelia*, P., of which the specimens leave no doubt. The figure above cited is too highly coloured in the mycelium, and would appear to belong to a different species.

Hymenoscypha.—I have no doubt that the specimens to which is attached the name of *Peziza scirpi*, Rabh., belong to *Helotium culmigenum*, Fr.

Mollisia.—The *Peziza arenula*, A. and S., of Fries's "Scler. Suec." No. 110, does not appear to be a *Peziza;* there is no fruit, and it greatly resembles *Leptostroma litigiosum*, Desm. More than one species of *Peziza* has borne the name of *Peziza juncina*, P., which *P. tephromelas*, Pass., resembles. It seems, however, to be a better species of *Patellaria* than of *Peziza*. Under *Peziza atrata*, P., the form on *Spiræa* appears to be identical with the *Peziza ulmariæ* of the "Handbook." The species published as a variety of *P. atrata* in "Fungi Britannica," No. 284, should rank as a distinct species under the name of *Peziza atrocinerea*, C.; it was found on *Polygonum aviculare*, and differs from the two or three other dark species on *Polygonum*, such as *P. Polygoni*, Lasch., and *P. Polygoni*, Rehm., for both of these differ in themselves. For the sake of distinction the latter may be called *P. Polygonorum*.

Durella.—It has been shown in "Grevillea," by the Rev. W. A. Leighton, that *Peziza resinæ* is a lichen, and should have restored to it the name of *Lecidea resinæ*. Also *Peziza Mougeotii* should be transferred to lichens. Under the name of *Peziza compressa*, P., two black *Peziæ* of like size and habit have been confounded. One of these

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apparently the most common British form, has minute sausage-shaped sporidia (·008 × ·002 mm.), to which the specimens in the Herbarium belong. The other has triseptate sporidia (·02 × ·004 mm.), and is the *Peziza macrospora*, Fckl.

HELOTIUM.—There is little to call for observation under this genus, except that authentic specimens of *Helotium cribrosum* and *Helotium claroflavum*—apparently from the late Dr Greville (the specimen from A. Jerdon under the latter name being different)—afford the means of determining the fruit. The sporidia in *H. cribrosum* are elliptical (·02 × ·01 mm.), uniseriate, smooth hyaline, or with a brownish tint; the paraphyses are also amber-coloured. *Helotium claroflavum* is not sufficiently mature for the sporidia to leave the asci; hence their precise nature could scarcely be determined with certainty. In some of the asci the contents were still granular; in others the linear sporidia appear to be ·027 × ·004 mm., but this determination is given with some diffidence. In *Helotium flavovirens*, from Dr Mougeot, the sporidia are filiform, nearly as long as the very long slender asci (·16 mm.). *Helotium æruginosum*, Fr., *Helotium versiforme*, Fr., *Peziza chlorascens*, and *Peziza chlora*, Schw., are included by Fries under *Chlorosplenium*.

PATELLARIA.—It should be determined what is the true *Peziza lecideola*, Fr., now usually included under this genus. The specimens published by Fries ("Scler. Suec." 137) in this Herbarium have narrow lanceolate, triseptate, hyaline sporidia (·012–·014 × ·006 mm.), almost identical with those of *Patellaria proxima*, B. and Br., whereas in specimens from C. E. Broome, I find them elliptical, uniseptate, and brown. In *Peziza lecideola*, distributed by Dr Curtis from the United States, the sporidia are very minute, sausage-shaped. Nylander gives the fruit of *P. lecideola*, Fr., as oblong-ellipsoid, triseptate, ·011–·015 × ·005–·006 mm., and by Karsten as triseptate, ·01–·016 × ·005–·006 mm. My own impression is, that the specimens in the Herbarium from Fries, agreeing as they do with other specimens published in "Scleromycetes," as cited by Nylander, should be accepted as the true *P. lecideola*, Fr. The specimens published in the same work by Fries ("Scler. Suec." No. 336) as *Patellaria atrata* are not *Patellaria*, but *Tympanis confusa*,

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Nyl. (see Nylander, "Observations," pp. 69). The sporidia are very minute, spermatoid, and numerous (myriospores), as in *Tympanis*, to which genus it clearly belongs. *Patellaria atrata* has quite different fruit, as usually understood. *Patellaria constipata*, Bloxam, is identical with *Patellaria livida*, B. and Br., to which must also be referred *Dermatea abietina*, Awd. in Rabenhorst's "Fungi Europæa," No. 1027. This plant appears to be congeneric with *Peziza carpinea*, P., and both would probably be better placed under *Dermatea*.

Tympanis.—The minute specimens of *Peziza plicato-crenata*, Schwz., from North America, derived from Schweinitz himself, the cups of which are ·5–1 mm. broad, enable us to determine it as a good species of *Tympanis*, with clavate asci, uniseriate sporidia, the latter unequally uniseptate, constricted at the septum, the upper and broader, but shorter, cell again at length uniseptate, the lower cell biseptate, so that ultimately there are four septa (·04 × ·012 mm.), and colourless. *Tympanis pinastri*, Fr., is another of the disputed, or uncertain species, the specimens from Fries ("Scler. Suec." 55) are barren. Two specimens, one of which apparently from Mougeot, are *Cenangium ferruginosum*, Fr., with simple, brownish, elliptical sporidia. The observations of Nylander ("Obs Pez. Fenn." p. 73) should be consulted, and compared with those of Tulasne in "Sel. Fung. Carp." The specimens of *Peziza farinacea*, B. (Fries, "S. S." 294), are in bad condition, but may probably be referred to *Peziza pinicola*, Fr., and this may be a *Triblidium*. *Peziza andromedæ*, Schwz, accords rather with *Tympanis*, or with *Cenangium*, as the specimen is not first rate, and contains only lunate stylospores.

Cenangium.—The specimens published by Fries ("Scler. Suec." No. 293) as *Cenangium acerinum*, Fr., is a very singular species. The paraphyses are slightly thickened above, very profuse, and in a mass of a deep bright blue at the top. The contents of the asci were assuming ovate forms, and if but little changed in the mature sporidia would be about ·012 × ·014 mm.

Agyrium.—It is generally admitted that *Agyrium rufum*, Fr., should be relegated to lichens. *Agyrium cæsium*, Fr. ("Scler. Suec." No. 279), has very small cylindrical asci, not more than ·035 mm. long. The form of the minute sporidia could not be satisfactorily distinguished.

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STICTIS.—The *Stictis atrovirens* of Fries ("Scler. Suec." No. 270), is referred by Fries himself ("Summa Veg. Scan.") to *Stictis atrocyanea*, Fr., the asci are clavate, and the sporidia fusiform, hyaline 3–7, septate ·04 mm. long. *Stictis mollis*, Fr., is in like manner referred to *Stictis pupula*. *Stictis pallida*, Fr. (S. S. 275), has triseptate sporidia ·02 mm. long.

PHACIDIUM.—The specimen of *Hysterium valvatum* from Appin, collected by Capt. Carmichael, is *Phacidium pini*. The specimen of *Phacidium rugosum*, Fr., in Fries's "Scler. Suec." (No. 355), has clavate asci very much stipitate, with sausage-shaped sporidia. *Phacidium rubi* (Fries, "Scler. Suec." No. 56) is unfortunately barren. *Phacidium Ledi*, Fr. ("S. S." 327), has only stylospores, or apparently stylospores, for no traces of asci were found. There is in the Herbarium specimens of what seems to be a minute *Phacidium* on leaves of *Empetrum nigrum*, very much smaller than *Xyloma Empetri*, D.C., which has linear, straight stylospores (·025 mm. long). *Phacidium multivalve*, Fr., from Mougeot and others, is what is referred to *Phacidium ilicis* in the "Handbook," the imperfect condition of which is *Ceuthospora phacidioides*. *Phacidium aquifolii* (Moug., No. 562) is much smaller, and has been found in Britain; it is the *Trochila ilicis* (Fries, "Summa Veg. Scan."), and differs from *Stegia ilicis*, Fr. *Excipula pithya* (Fries, "Scler. Suec." No. 172), is not a *Phacidium*, but probably a *Tympanis*, although Fries has referred it to *Triblidium*. It seems to be distinct from *Cenangium pithyum*, B. and C., but whether the same as *Tympanis pithya*, Karst, I have had no opportunity of determining. The sporidia appear to be immature, filled with granular matter, but whether myriosporous or not could not be determined. *Phacidium fibrosum*, Fr. ("Scler. Suec." 162), is referred by Fries himself to *Peziza pinicola*, Reb.

HYSTERIUM.—The specimen of *Hysterium varium*, Grev. ("Crypt. Flora," t. 233), which is the *Hysterium Carmichaelianum*, Berk., from the late Dr Greville, is of great interest as proving the character of the fruit in this species. The sporidia greatly resemble those of *Hysterium repandum*, Blox., but larger, *i.e.*, they are uniseriate, dark brown, ovate, with a hyaline apiculus at one end ·03–·032 × ·018 mm., whereas those of *H. repandum*, Blox., are ·025 × ·015 mm. A few

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threads of a black mould are mixed with the perithecia which have a pale stem, and an opaque, brown, subglobose head, rather larger than the sporidia. This mould may have some connection with the *Hysterium*, but of this there is no evidence. The small fragment of *Hysterium insidens*, Schwz., from Schweinitz, is identical with specimens I have received from North America, and is evidently the same as that alluded to by Duby ("Hyst." p. 26), under *H. complanatum*. It is clearly distinct from the latter species, has biseriate, brown sporidia (·045–·05 × ·015 mm.), somewhat fusiform, straight or curved, about 9 septate, with the cell above the centre largest and swollen, about 3 septa above, and 4 or 5 below. *Hysterium varium*, Fries (apparently from Fries himself), is unfortunately quite exolete, not a single sporidium could be found to show whether Duby's determination is correct. There are at least sixty good species of *Hysterium*, independent of those now usually grouped under other genera, that is, of *Hysterium* as understood by Duby. Of this number nearly one half are found in the United States. A very singular species occurs on reeds in North America, in which the sporidia are clavate, bright brown and multiseptate, more resembling the sporidia of such species of *Patellaria*, as *P. atrata*, except in the sporidia being coloured. When Duby published his memoir, and from that period almost to the present, the genus *Colpoma* has been regarded as consisting of a single species, the very common *Colpoma quercinum*. Having examined specimens of what is clearly the *Hysterium Azaleæ* of Schweinitz from the United States, I was at once convinced that it was congeneric with *Colpoma quercinum*. The sporidia are filiform, the length of the ascis, and the paraphyses very long, curved and twisted at the tips after the manner of a corkscrew; in both these features it resembles the other species. More recently, or in 1872, I had specimens sent me on juniper of an allied species, *Colpoma juniperinum*, C. and P., in this also the sporidia and the paraphyses resemble the others, so that here are three good species of *Colpoma*.

The majority of published specimens of *Hysterium petiolare* are referable to *Peziza erumpens*, Grev. In other instances, where an *Hysterium* is found on the petioles of *Acer*, the species does not seem to be distinguishable from

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Hypoderma virgultorum, var. *petiolare*. The *Hysterium plantarum*, Schuz., belongs also, as I believe, to *Hypoderma*.

STEGIA.—*Stegia arundinacea*, Fr., is represented by the specimens in Fries's "Scleromycetes Suecicæ," No. 352, and Mougeot and Nestler's, No. 983. There has been some confusion with this species, which is the *Peziza Kneiffii*, Wallr, as indicated by Messrs Berkeley and Broome in "Annals of Natural History" (Jan. 1875). The specimens published by Fries himself, by Mougeot and Nestler, and by Desmazieres all agree with each other and with a specimen I received from the late C. Montagne. The asci are from ·07 to ·08 mm. long, the sporidia linear, and about ·008 mm. long. Fuckel has apparently found the same thing, but he describes the sporidia as fusiform and 1–2 nucleate ·008 × ·0025 mm. Possibly the nuclei disappear with age, which may account for their absence in the specimens now examined. Under the impression, I presume, that *Peziza Kneiffii*, Wallr., was something distinct from *Stegia arundinacea*, or as at one time written *Eustegia arundinacea*, Fr., several fungi have been published under that name. In the British Museum collection are specimens of a form of *Peziza fusca* named by Bloxam *Peziza Kneiffii*, which is clearly an error. Montague's plant was named by himself *Peziza Kneiffii*, but on re-examination, although at first disposed to think otherwise, I am convinced that it is the same as *Stegia arundinacea*, Fr., with the pseudo-subiculum more highly developed. The most recent instance of substitution occurs in Rehm's "Ascomyceten," in which, under No. 113 is published a species there called *Peziza Kneiffii*, which is altogether different from *Stegia*. It belongs to the sessile *Dasyscyphæ*, the cup being densely clothed with long delicate tawny hairs, although these are quite colourless when magnified 400 diameters. The asci in this species are ·06 mm. long, and the linear curved, or sausage-shaped sporidia, are ·015–·017 mm. long. This species I have called *Peziza* (*Dasyscypha*) *Winteri*, Dr Winter having described most of the new species published by Rehm. It may be remarked that in the form of *P. fusca*, which Bloxam has called *P. Kneiffii*, the asci are also about ·06 mm. long, and the similar sporidia ·013 mm. long. The sporidia of *Eustegia arundinacea*, Fr., appear to be variable, for I find them in Mon-

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tagne's specimens to be ·013 mm. long. Fuckel gives his measurements as ·008 mm. long.

Bloxamia.—It has been hitherto somewhat uncertain where this genus should be placed. It appears to me that its nearest affinities are amongst the *Stictei*, probably next to *Agyrium*. The only known species is *Bloxamia truncata*, B. and Br.

II. *Wheat and Rye Hybrids.* By A. Stephen Wilson.

The following experiments were begun in July, 1873, for the purpose of testing whether hybrids could be produced between any two of the grasses, Wheat (*Triticum sativum*, L.), Spelt (*Triticum Spelta*), Rye (*Secale cereale*, Will.), Barley (*Hordeum distichum*, L.), and Oats (*Avena sativa*, L.), all of several varieties; or between these and Darnel (*Lolium temulentum*, L.), Wheat-grass (*Triticum repens*, L.), Wild Oat (*Avena fatua*, L.), and Fly Oat (*Avena sterilis*, L.)

The number of florets treated was between 400 and 500. And when an experimenter goes through a good deal of labour, perhaps he may be pardoned for expecting positive results. Undoubtedly the proper scientific spirit to cultivate is not to anticipate results at all. The results of the present experiments were mostly negative; but whether they were negative from unknown facts hostile to hybridisation in the florets treated, or from failure, through ignorance, to impress the proper conditions into the experiments, cannot be here determined.

Only a general description of the methods employed need be given. When a floret of wheat, rye, or any of the others, was observed to be opening, the pollen was shaken into a test tube. In other cases, when it was known that the opening was about to take place, the ear was drawn through the hand and several sets of anthers brought out at the same time, thus securing a good supply of pollen. The ears of other plants were then watched for opening florets. In most cases the anthers of these florets were removed with a pincers before discharge had taken place, and pollen from the test-tube dusted upon the stigmas with a camel-hair pencil. In many cases opening was induced at various stages before the natural date of opening. In some cases

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the anthers were not removed, but only the cross pollen applied. The endeavour was made to have a certain number of experiments under all the conditions which it was thought likely would favour fertilisation. It may be mentioned that all the plants were growing in ordinary circumstances in the open air. The earlier stages, when the anthers and pollen are greenish white, were avoided, florets being mostly selected in ears which had begun to flower and in which the anthers were bright yellow or purple.

All the spikes and florets treated were marked by numbered tickets attached to them, and the conditions registered under which the experiment was made— such as what pollen was applied, whether the floret opened naturally, or was opened otherwise.

When the ears were ripe they were cut and collected for examination. Many had produced seeds, and many were barren, and many had fallen into the hands of the sparrows and were eaten up.

All that remained were put aside. Only two or three presented any abnormal appearances; they were swelled out into an unusual shape. The others were no way distinguishable from ordinary kernels of the respective grasses.

Of course it was impossible to tell whether these seeds were hybrids or not. An experiment which should detail that a cross had been effected between two wheats, because something had been produced not quite corresponding to either parent, might still be fallacious. We do not know that the removal of the anthers immediately after self-fertilisation would be without effect.

All the seeds of the various kinds were placed on damp cloth between inverted plates, in the spring of 1874, to discover which were alive and which were dead. A great many never vegetated; so that, when I came to plant my treasured hybrids, not many flower pots were sufficient for that purpose.

But the oat seeds grew up oats, and the wheat seeds grew up wheat, and the barley seeds grew up barley, and the rye grew up rye, all with the exception of the two plants, six stems of which are submitted to the Society. These are from wheat ovules and rye pollen, and the whole aspect of the culm and ear is intermediate between rye and

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wheat. The elongation of the outer pales into awns midway in length between the blunt termination in wheat and the longer needle of rye is the most noticeable feature. The thinness of the culm is characteristic of rye, and so is the slight villosity below the ear, not so observable now as when green. The glumes, also, are intermediate in size between those of wheat and rye.

All the florets on these spikes fully opened, as if intending fertilisation, and on some of the ears they did not close again. But what seem to be the most important facts regarding these hybrids are, that the anthers did not open nor discharge any pollen; that the pollen was imperfectly developed and contained very little fovilla; and that the imperfect grains remain in the dried anthers. These facts are a sufficient reason why these hybrids are absolutely barren; not a single kernel having been produced. The anthers did not get blanched as empty anthers do, and instead of falling away as is usual they still remain attached, so that the imperfect pollen may be examined by breaking up an anther in a drop of water. The anthers are of the wheat size. In the ordinary fertilisation of a grass, the pollen grains continue to grow until they rupture the anther; in these hybrids this full growth of the pollen grains has been arrested.

It would be going further than caution warrants to affirm positively that the plants under notice are hybrids beyond all doubt. Whole spikes of the cereal grasses are sometimes barren, or at least remain unfertilised; and other circumstances than the transfer of the reproductive elements may have brought about the peculiar structure and the sterility of the supposed hybrids before us. But as the experimenter has considerable reason for believing these plants to be actually hybrids; and as the immediate cause of their sterility is a true and sufficient cause, and not some fancied purpose of nature; he presumes to submit his observations for what they are worth to those who may intend going further into the subject.

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4th May 1875.—Sir ROBERT CHRISTISON, Bart., M.D., D.C.L., President, in the Chair.

The following Communications were read:—

I. *The Rare Lichens of Glencroe.* By Rev. HUGH MACMILLAN, LL.D., F.R.S.E.

During the months of August and September last, after my return from Switzerland, I spent my holidays, along with my family, in a solitary farm-house in Glencroe, at the head of Loch Long. This farm-house is called Larich Park, and is situated about three quarters of a mile from the entrance of the glen, and about three miles from Arrochar. Glencroe is six miles long, leading from Loch Long to the elevated plateau of "Rest and be Thankful," the scene of one of Wordsworth's sonnets, and famous from the use made by Lord Russell of it as a parliamentary phrase. The coach road from Arrochar to Inverary passes through it. The scenery of the glen is remarkably wild and desolate. Rugged mountains from two to three thousand feet high,—their sides strewn with boulders, and seamed with torrents,—overhang the road, and approach at their base from either side so closely, as to leave but a very narrow passage for the river, which has worn for itself a strangely tortuous and deeply indented channel through the rocks. There are only three or four human habitations in the whole glen, and but two small portions of cultivated land,—the rest being given up to pasturage for sheep. That part of the glen, immediately surrounding the farm of Larich Park, combines in a remarkable manner the grand and the beautiful. Ben Arthur, or the Cobbler, rises on one side to a height of 2863 feet; its precipitous sides covered with rich vegetation, and marked by white waterfalls, and its summit consisting of a huge aiguille of rock, which appears and disappears at intervals through the driving mist with a singularly weird and wild effect. On the other side of the glen towers up a ridge of equally steep and rocky peaks, terminating in a great shattered rocky crown called Ben Unack, only 200 feet or so lower

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than the Cobbler. While at the entrance of the glen, on both sides of the river, which forms here a promontory or delta of alluvial soil projecting into Loch Long, repose in quiet beauty between the mighty masses of rocks and hills, the luxuriant woods of Ardgarten, composed of fine old pines, beeches, and oaks. This part of the glen has a southern exposure; and owing to its narrowness and the loftiness of the mountains around it, enjoys a mild, moist climate, as may be seen by the luxuriant development of grass, bracken, and rushes upon the hills, instead of heather. The prevailing formation is micaceous schist, considerably distorted and of varying hardness, and a quartzose flagstone.

Residing on the spot continuously for so long a period, I had abundant opportunities of exploring the cryptogamic flora of the glen, which I presume had never previously been investigated. The Cobbler and the surrounding mountains yield nothing of any particular interest, producing the common lichens and mosses which are found everywhere at similar heights; in this respect contrasting remarkably with the rich variety of rare Alpine species which are found on the Breadalbane mountains, not twenty miles distant in a straight line, and whose climate and soil are very much the same. The base of the hills at Glencroe, however, more than made up for this deficiency. On the western side of the river, immediately opposite Larich Park, huge fragments of micaceous rock, which had evidently fallen ages ago from the cliffs overhead, strew the green slope of the hill. These fragments are somewhat numerous, and conspicuous in one spot. They are covered with the usual lichenose vegetation of a sub-alpine glen, such as Stereocaulons, Sphærophorons, Cetrarias, and Parmelias, all spreading luxuriantly, and attaining unusual proportions, indicating that they find in this place the peculiar conditions of shade and shelter, and the mild moistness of the air in which lichens delight. Among the common species I picked out several rare lichens which interested me greatly. One of these is the *Parmelia lævigata* of Acharius. This species is one of the largest and handsomest of the British lichens. It forms very broad, conspicuous patches on the rocks; one individual often

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extending upwards of a foot in length and breadth, and covering continuously the whole exposed side of a boulder. It adheres very loosely to its growing place by means of its black shaggy underside. Its upper surface is smooth and greyish-white, cut up into numerous lobes and segments; the ultimate ones dividing into two or more very narrow branches whose extremities are turned up, and covered with grey powdery warts or soredia. The lichen consists of a series of these segments, often imbricated. The curious abrupt divisions of the larger and broader lobes, into two or more acute linear ones, crowned with mealy tubercles, is a characteristic which cannot be mistaken, and serves effectually to distinguish this from all other lichens. It is, indeed, one of the best defined species we possess. The apothecia, which are very hollow, and of a dark red colour, with an entire crenate or sorediate border, are extremely rare. There were none on the individuals which I gathered, and I believe they have never been found in this country, being described from foreign specimens. The lichen itself is exceedingly rare. The late Mr Borrer is reported to have found it in Ross-shire and at Ballachulish; but his discovery has not been repeated in these localities by any other botanist. The latter region I searched pretty minutely for two days while on a yachting cruise in the summer of 1873; but I failed to find specimens either of this lichen or of the three or four other extremely rare lichens which Mr Borrer, and no one else, gathered there. It is therefore an important circumstance that a new locality for the *P. lævigata* has been found in Scotland, which is more accessible, more easily pointed out, and where it occurs in considerable abundance. In England it has been found on Dartmoor and in St Leonard's Forest, and on rocks in the island of Anglesea, at Dolgelly in Carnarvonshire, and in one or two other places in South Wales, in Jersey and Guernsey, and in Ireland in Askew Wood, County Kerry. In England, Wales, and Scotland its distribution is thus confined to the west coast. We can trace it along a narrow line that never goes into the interior, or curves to the east, from Devonshire to Ballachulish. It is eminently a southern lichen, and loves moist, mild, sheltered localities within reach of the sea,

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probably depending, like the *Ramalina scopulorum* and its own congener *Parmelia aquila*, for its growth and well-being upon some constituent in the sea-air. It has been found sparingly distributed throughout the continent of Europe in localities similar to those which it affects in this country; and specimens have been sent from the valley of the Amazons in South America, and from gneiss and basalt boulders in Middle Island, New Zealand, where the thallus is slightly yellowish. It admits of being suggested that Glencroe and Ballachulish were colonised by spores from Wales and the south-west of England, blown northwards by the south-western breezes which penetrate to the heads of our western sea-lochs lying directly in their course. Or we may suppose that the lichen exists in other localities on the western sea-board of Scotland, and awaits discovery there; this region being confessedly very imperfectly explored by cryptogamists, and may be expected to yield, as in the case of the discovery of the *Myurium Hebridense* by the side of Loch Coruisk in Skye by myself, and in South Uist and other localities by others, to a thorough search, results as interesting as they are novel. If the latter supposition be adopted, the lichen might be regarded as indigenous to the region; and we might as reasonably imagine it to have migrated from Scotland to the English and Welsh stations, as to have been derived in the northern localities from the southern. I am disposed to class it with a peculiar group of large highly-developed lichens, comprising the tropical Stictas, &c., found in the south-west of Ireland, and in a few isolated spots in Scotland and England, which may probably have had an American origin, and may be connected with the late geological changes that have taken place in the relations between the Old and New Worlds.

Associated with typical specimens of the *Parmelia lævigata* I found several others which appeared to me to differ very considerably from them, and to present several abnormal peculiarities. The more I considered them, the more puzzled I became. At first I took them to be mere varieties due to certain conditions of soil and exposure. But a more attentive examination led me to the conclusion that they belonged to a distinct, but to me unknown species. I

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laid the specimens before Dr Stirton of Glasgow, upon whose critical judgment I could place the utmost dependence. After subjecting them to microscopical examination of their physical peculiarities, and to those chemical tests initiated by Nylander, which have lately proved so useful in identifying species so closely allied as to be otherwise confounded, he came to the conclusion that they were entirely new to science. Dr Stirton, therefore, did me the honour of naming the lichen after me as *Parmelia Millaniana.* Subsequently, however, I sent a small specimen to the Rev. Mr Leighton; when he assured me that it was identical with his *P. endochlora*, found by Dr Taylor in Askew Wood, County Kerry, Ireland, associated, as in this country, with *P. lævigata.* In these circumstances, although the discrepancies between Mr Leighton's published description, and the characteristics of my plant were sufficient to warrant Dr Stirton and myself in regarding it at first as new, I have now no alternative but to yield, which I do cordially, to Mr Leighton's prior right of nomenclature, and adopt his name. The lichen in question, as I have said, is at first sight very like *P. lævigata.* But by scraping the upper surface, the medulla is found to be of a decidedly yellow colour; whereas the medulla of the *P. lævigata* is pure white. The action of the reagent produces in the new lichen a deeper yellow, amounting almost to an orange tinge; whereas the chemical reaction of the *P. lævigata* is bright unchangeable red. The hairs on the under-surface are also different, being much more dendritic and branched. The whole facies of the lichen is such as to distinguish it at once, when attention has been directed to it. It is less lax in its habit than *P. lævigata;* clinging more closely to the rock, and its ultimate segments are not divided in the same way as in the allied species, but terminate in rounded lobes covered with mealy powder, or else are matted together into a series of little imbricated fragments. Tuckerman, in his "North American Lichens," has recorded a species under the name of *P. aurulenta*, which in some respects resembles the plant under consideration, but differs in others. *P. endochlora* is almost as abundant in Glencroe as *P. lævigata.* It is always found associated with that species, on the boulders which strew

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the hillsides between Ardgarten and Larich Park farm-house. It occurs on both sides of the river, but is less abundant, and less common on the slopes of the Cobbler. It spreads sometimes in wide masses over the shady sides of loose moorland walls, or isolated stones half sunk in the ground, and partially covered with grass or moss. Creeping twigs of heather and willow are also frequently invested with it. Seeing that it is so common and abundant in this locality, I am astonished that it has not hitherto been observed in Scotland. I am prepared to hear that it has been discovered in other localities along the western seaboard of Scotland, now that attention has been directed to it.

While fishing one day in the river Croe, a little above Larich Park farm-house, I noticed on the upper side of a huge rock in the middle of the stream that rises high above the water, a number of specimens of the very rare *Parmelia diatrypa* of Acharius, adhering closely to the stone. In some the centre had disappeared; while others were perfect in shape and filled up from centre to circumference. This is one of the neatest and most beautiful of our lichens, having a smooth, waxy, shining appearance, and its segments being exceedingly regular, raying out in a close laciniated form. I afterwards found it somewhat abundant on mossy rocks and on the lower part of the trunks of pine trees in the Ardgarten woods beside the path, a little beyond the bridge that spans the river. The specimens on the pine trees differed a little from those on the rocks, being inclined to be more sorediate at the apices of the segments, and greener and more shining in colour. The smaller size, narrower segments, polished waxy appearance, and, above all, the minute perforations of the segments, serve effectually to distinguish this species from *P. physodes*, with certain states of which, especially when growing on rocks, it might at first be confounded. It is exceedingly rare in fructification in this country. In New Zealand, where it seems to be rather common and widely diffused, it fruits freely; and its bright red apothecia, with their greyish entire margin, are a great ornament to the plant, and complete the beauty of its appearance. In Scotland it was previously known only to occur at Ballachulish, where Messrs Turner

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and Hooker gathered it. In England, Dr Greville found it on moist mossy rocks at the foot of Snowdon; and Dr Taylor and Mr Carrol in several places in the south-west of Ireland. It is exceedingly local in this country, but has a wide distribution over the world, having been found in Europe, Asia, America, Australia, the Sandwich Islands, and New Zealand. With us the *P. physodes* is exceedingly abundant everywhere, and the *P. diatrypa* exceedingly rare and local; but in New Zealand it is exactly the reverse, the *P. diatrypa* being the common, and the *P. physodes* the rare species. I gathered the *P. diatrypa* abundantly on pine trees in the woods of the Kleine Rugen at Interlaken, Switzerland; and on boulders in the Nâerodal at the head of the Sogne Fjord, Norway. The old specific name which Acharius gave it has been changed for the more descriptive new name of *P. pertusa* of Schrank, under which, in recent works on lichenology it is now known. On the same trees of Ardgarten woods, I may mention, I observed magnificent specimens of *P. physodes* in the most luxuriant fructification, every segment loaded with apothecia, varying in size from a pin-point to a fourpenny piece.

On one solitary pine tree, in the same part of the Ardgarten woods, I found a few specimens of a lichen which I identified as the *Parmelia Mougeotii* of Schærer. Leighton includes it as a mere variety under *P. conspersa.* It is found most frequently on boulders; and I observed subsequently a few specimens on a quartz rock near the farm-house. It may be distinguished by its greenish yellow stellated thallus, rarely attaining more than an inch in diameter; the somewhat convex laciniæ being very narrow and multifid, and bearing powdery warts of a lighter colour at their extremities. It is closely fixed to the bark on which it grows. Most of the specimens observed are very minute, but quite characteristic notwithstanding. The fructification is altogether unknown. The lichen has been found in several places in England, Wales, and Ireland; while in Scotland Professor Dickie gathered it near Aberdeen, Dr Hall in the fir woods of Dunkeld, and the Rev. Mr Crombie in the pine woods of Glendee, Braemar. Although considered very rare at present, it is probable that it may yet be found in many subalpine localities where pine woods

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prevail; its minute size being likely to cause it to be overlooked.

On the same pine trees I also gathered, what I concluded to be one of the numerous forms of that protean lichen, the *Parmelia tiliacea* of Acharius. It grows on stones and trees somewhat abundantly in the district, but it assumes such different appearances, and departs so widely from the normal type, that it is almost impossible to identify all the varieties. The saxicolous specimens as a rule are much more luxuriant, membranous, and wide-spreading, and less divided than the corticolous ones. When growing in favourable localities, and particularly on the ledges of rocks in the beds of streams, where a considerable quantity of soil has lodged, and which are exposed to occasional inundations, the lichen grows to a large size, and presents a very tough and corrugated appearance; portions of the thallus being much broader and thicker than the others, and marked by numerous rough wrinkles. In the typical plant the thallus is orbicular and membranous, inclined to be pruinose in the centre and divided into somewhat rounded lobes, marked by crenated sinuses. The upper surface varies from a greenish or glaucous grey to a silvery white colour. The under surface is brownish black and a little fibrous, not nearly so shaggy as in *P. lævigata*. The flat orange-brown apothecia with an inflexed border are unknown to me. Indeed, none of the rare lichens of Glencroe were observed in fruit. The vegetative system, which in all of them was remarkably luxuriant, seems to have been developed at the expense of the reproductive. What are the conditions upon which the production of apothecia in lichens depends is at present involved in mystery. The *Parmelia physodes*, a species which very rarely fructifies, produces the most abundant and luxuriant apothecia in the same wood, and on the same trees where other species nearly allied are invariably and inveterately barren. We know the laws which determine the appearance of sexual organs on flowering plants, but are ignorant of those which determine the development of the sexual organs of the cryptogamia. This is a field in which most interesting and important discoveries may yet be made. The *Parmelia tiliacea* is peculiarly an English species, being

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found not unfrequently on trees in the south-west of England, and on rocks in Anglesea and Carnarvonshire, associated with *P. lævigata*. Indeed, where the one lichen grows the other is almost sure to be found in the neighbourhood, for they love the same localities and the same conditions of growth. Previous to my finding the *P. tiliacea* in Glencroe, it had been gathered only in one spot in Scotland, on the battlements of Brodick Castle in the Isle of Arran. In the south-west of France it occurs in abundance on olive trees, and produces rich fructification.

Various forms of the *P. tiliacea* approximate to the typical *P. scortea* of Acharius. I found on a loose dyke running down into Loch Long, at the end of the Ardgarten woods and the entrance of Glencroe, very remarkable specimens which come under this description.* They occur nowhere else than on the above-mentioned wall, growing above high-water mark, covering every exposed stone, and giving to the whole dyke, along with its gay garniture of yellow Parmelias, a peculiarly picturesque appearance. The thallus is orbicular, spreading widely from the centre to the circumference; the central parts decaying and disappearing, and the circumferential parts maintaining the life and growth of the lichen. In texture it is membranous, almost cartilaginous, tough, and wrinkled. It is lobed and sinuated in a very regular manner, and its colour is of a greyish-white, slightly darker at the edges, and covered with innumerable black granulations, which are spermogones, propagating the plant in the absence of its bright chestnut apothecia with an inflexed crenated border, which are extremely rare, having never been observed in this country. In England the typical lichen occurs usually on trees and poles, and grows in sheltered places. I am not aware of its having been found in any other place in Scotland save that which I have described; and the circumstances of its habitat there, growing on stones exposed to the stormy breezes of the sea-shore, alternately moistened by the spray of the waves, and dried and hardened by the hot sunshine, must have modified considerably its appearance, and are sufficient to account for the difference which the Scotch specimens present to the English ones. In regard to such

* Mr Leighton refers them to *P. tiliacea* var. *rugosa* of Taylor.

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a plant as this, we feel the truth of a somewhat paradoxical statement made by a great botanist, that "in other tribes of plants the more we study them the more species we discover, whereas among the lichens, the more we study them the fewer species we find."

Since the preceding observations were read to the Society, I have revisited Glencroe; and having lived in the same farm-house for a somewhat longer period, I had ample opportunities of going over the ground again more carefully. I found *Parmelia sinuosa* of Acharius somewhat abundantly on small weather-worn boulders on the slopes of the Cobbler, particularly at the foot of the long incline which rises straight from the Ardgarten woods. I saw it in even finer condition on mossy rocks on the banks of the river opposite the farm-house and a little higher up the glen. I also found it sparingly distributed on the trunks of birch trees on the shores of Lochlomond, about two miles above Tarbet. It occurs on stones and walls throughout Scotland, but is always local and scarce. It is more frequently found on moorland stones in Dumfriesshire than anywhere else; and I have gathered fine specimens on granite boulders near New Abbey. It is easily known by its pale primrose colour, and its dilated cloven lobes and circular sinuses, and the dense black fibres of its underside. It is a very lovely species even in the fragmentary form in which it usually occurs; but when it is well grown and complete, it is one of the most beautiful British lichens.

At the foot of boulders half sunk on the hill sides, I found a few specimens of *Parmelia speciosa* var. *hypoleuca*. This handsome species crept over the mossy turf, among tufts of cup-lichens. It assumed a somewhat broken, fragmentary form, and some of its fragments presented a close resemblance to the segments of the thallus of the cup-lichen among which they grew. Its texture is somewhat thick and cartilaginous. Its colour on the upper surface of the thallus is of a pale greenish-white. The under side of the typical species is pure white, interspersed with a few grey fibres, but the variety *hypoleuca* is distinguished by its black ciliæ and rhizinæ. Its form is stellated, radiating from the centre in numerous linear multifid segments,

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broadening, and powdery at the extremities, and somewhat imbricated. The apothecia have not been found in this country, where it has been gathered only by Messrs Turner and Hooker, at Ballachulish. It occurs somewhat commonly in North America and in Switzerland; in which latter country I have gathered magnificent specimens in pine woods at a great elevation.

I was fortunate also in finding upon a single ash tree in Ardgarten woods, several diminutive specimens of the rare *Sticta crocata*. This tropical lichen, easily distinguished by the lemon-coloured powdery spots which mark the reticulations of the upper surface, I observed some years ago in the woods of Moness at Aberfeldy. It occurs in the woods at Inverary, to which Glencroe leads; and I am informed that it is very abundant and luxuriant in form on trees in Islay.

Besides the very rare species described in the preceding paragraphs, an abundance of common, though still local lichens, occur in Glencroe; such as *Endocarpon læté-virens*, *Bœomyces rufus*, *Lecidea sanguinaria*, *Squamaria lanuginosa*, *Placodium plumbeum*, *Parmelia caperata*, *conspersa*, *perforata*, *perlata*, and *aquila*, *Sticta pulmonaria*, *scrobiculata*, *limbata*, *fuliginosa*, and *sylvatica*, *Collema Burgessii*, *Peltidea scutata*, *Nephroma resupinata*, and *Gyrophora pellita*.

I have thus described the small but rare and interesting group of Parmelias which I discovered in Glencroe; and the fact that so many large and beautiful lichens should have been found for the first time in Scotland, in a region so near to our large cities, so much frequented by tourists, and so well known to the general public, shows conclusively that much requires still to be done in ascertaining the geographical distribution of our lichens, and encourages the hope that still more important discoveries will reward the search of the indefatigable cryptogamist in districts less known and frequented.

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II. *The Rarer Plants of the Province of Ontario.* By Prof. John Macoun, M.A., and Prof. John Gibson, B.A., F.G.S., Albert College, Belleville.

Geographical Notes.—The territory within which the following plants were collected embraces that portion of Canada bounded on the south by Lakes Erie and Ontario, the Niagara River, and that part of the St Lawrence proper, west of the embouchure of the Ottawa. On the east and north-east the Ottawa forms the dividing line separating Ontario from the Province of Quebec. The northern limit is defined by a line joining Lake Temiscamang on the Ottawa, and Fort William on Thunder Bay, Lake Superior; while on the west Lakes St Clair and Huron, the Detroit River and the eastern and north-eastern shores of Lake Superior to Thunder Bay form the boundary lines. Roughly considered, this portion of North America may be geographically defined as a peninsula running southward from the 47° N. lat., to a point on Lake Erie in about N. lat. 42°, and extending eastward and westward between the respective lines of longitude 74° 50′ W., and 89° 22′ W. The northern portion of this peninsular region, or more definitely, the country between the Upper Ottawa and Lake Superior, is occupied chiefly by the Metamorphic series of rocks known as the Laurentian. These rocks, which may be recognised as the equivalents on this continent of the so-called fundamental gneisses of the isles of western Scotland, and of parts of Ross-shire and Sutherlandshire, lie at the base of all our sedimentary series. They are all metamorphic and altered to a highly crystalline condition, and are composed of feldspathic rocks interstratified with important masses of limestone and quartzite. Great beds of gneiss, moreover, containing chiefly orthoclase or potash-feldspar (silica = 64·8, alumina, 18·4, potash, 16·8 = 100), and other portions containing no quartz, but composed almost entirely of a lime-soda feldspar, varying in composition from andesine to anorthite, and associated with pyroxene or hypersthene, are especially characteristic of this system, and are everywhere observable over the northern districts of Ontario. Here the highest summits do not apparently exceed 1500 or 1700 feet above the sea, though one ridge near the sources of the Muskoka and the Petewahweh

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attains the approximate height of 2300 feet. On some of the northern tributaries of Lake Nepissing, and along the French River, may be observed a series of parallel peaks attaining altitudes ranging from 1200 to 1600 feet. As we proceed westward, however, the average summit-level of the country gradually descends, and on the northern and north-eastern coasts of Lake Superior, and in many places along the northern shore of Lake Huron, we find that 1000 feet would approximately represent the general elevation of the region. Most of these heights, however, belong to points more prominent than the country surrounding them, and it may not be presenting too low an estimate of the average altitude of the Laurentide area in Canada to call it from 1200 to 1500 feet. The surface generally is of a mammillated character, its hills and peaks having been worn down by glacial action into rounded knolls or hummocks like the *roches moutonnés* of the Alps. The intervening depressions or valleys are in general not very wide, and many are simply abruptly-faced pits, holding numerous small lakes and ponds united into tortuous chain-like courses by their short discharging channels. These are scattered in prodigious numbers over the whole Laurentide country, and when viewed on a map appear to follow such a haphazard arrangement as to contradict any supposed law of distribution. The more prominent elevations are in general thickly clothed with evergreens, in some parts chiefly pine (*Pinus Strobus*, L., and *P. resinosa*, Ait.), and in others spruce (*Abies alba*, Michx.), whilst in the depressions is represented with striking beauty and regularity what might be termed a concentric arrangement of vegetation, particularly noticeable among the arborescent forms. The lower portion of the valley—that area immediately contiguous to the central lake or pond, which may be presumed to exist in every such depression—may be denominated the sphagnous area, characterised by *Sphagnum cymbifolium*, Dill., various forms of *S. acutifolium*, Ehrh., and *S. laricinum*, Spruce; surrounding which is the Tamarack belt (*Larix americana*, Michx.), still carpeted by the same species of Sphagnum. Approaching the rim of the depression, there occurs with similar regularity another belt, which may be characterised as the cedar (*Thuja occidentalis*, L.), associated most commonly

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with *Ledum latifolium*, Ait., *Alnus incana*, Willd., *Rhamnus alnifolius*, L'Her., and *Cornus stolonifera*, Michx. Encircling the latter zone, and bounding the depression, is found the Black Ash belt (*Fraxinus sambucifolia*, Lam.), embracing, among other forms, *Ulmus americana*, L., *Betula excelsa*, Ait., *Acer rubrum*, L., *A. spicatum*, Lam., *Ribes rubrum*, L., *R. lacustre*, Poir., *R. hirtellum*, Michx., and *R. nigrum*, L. The general physiognomy of the vegetation of this portion of Ontario is characterised by a marked preponderance of boreal species, whose existence here must not be attributed so much to the influence exerted by the geognostic peculiarities of the soil, as to the aggregate condition of the soil, taken in connection with the different factors of temperature and moisture. Lofty and rugged as in many places may be the character of the Laurentian area, still we are not warranted in ascribing to these features any very important influence on the free distribution of the different indigenous forms of the province, nor are the Laurentide ridges of sufficient height and extent to impede in any but the slighest degree the admission of the cold boreal winds from the district of the Hudson Bay and its tributaries. It is therefore to the climatological features of this region, consequent on elevation and a general northern bearing, and not to the chemical constituents of its soils—however much there may be in this relationship—that we must ascribe the existence of a flora of a general northern character. Some few species could be cited which have not hitherto been detected as habitats other than Laurentian or Laurentian-transported debris, but such instances may in almost every case be taken merely to illustrate *preferences* for this soil and strata. It is sufficient here to mention only the more important of those regarded as truly Laurentian, whose presence in most cases, however, may be explained by their known predilection for northern localities.

Ribes prostratum, *L'Her.*
Aralia hispida, *Michx.*
Spiræa tomentosa, *L.*
Polygonum cilinode, *Michx.*
Kalmia angustifolia, *L.*
Pinus Banksiana, *Lamb.*
Pinus rigida, *Miller.*
Potamogeton Vaseyi, *Robbins.*
Potamogeton Spirillus, *Tuckerman.*
Carex Houghtonii, *Torrey.*
Carex lenticularis, *Michx.*
Asplenium ebeneum, *Ait.*
Woodsia ilvensis, *R. Brown.*

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Isoetes riparia, *Engelm.*
Sphagnum squarrosum, *Pers.*
Dicranum fulvum, *Hook.*
Dicranum spurium, *Hedw.*
Trichostomum glaucescens, *Hedw.*
Grimmia Olneyi, *Sulliv.*
Hedwigia ciliata, *Austin.*
Bryum crudum, *Schreb.*
Fontinalis antipyretica *var.* gigantea, *Sulliv.*
Climacium dendroides, *Web. et Mohr.*

Before passing on to some generalisations upon the physical features of South Ontario in connection with its phytogeography, it may be interesting to make a few observations on the more salient points relating to the distribution of the Lake Superior flora. The facies of the vegetation is likewise decidedly boreal, the characteristic types being in the generality of cases essentially sub-arctic-adventurous immigrants from the north-western districts of America. A few stragglers range southward, and are found on the northern and north-eastern shores of Lake Huron; the so-called Bruce Peninsula in Ontario, situated between the lake proper and the Georgian Bay, apparently limiting their southern range of migration. Their occurrence on the shores of these lakes, several hundred miles to the south of their most southern limit either eastward or westward, would seem to indicate conclusively the existence here of conditions of soil and climate analogous to those under which these same species flourish in more northern latitudes. A low temperature and a humid atmosphere would here, as in the case of the Laurentide species, appear to be the causes favouring the presence of these little northern adventurers.

Those species peculiarly sub-arctic are found in most cases growing near the water's edge upon dykes of porphyry or diorite, standing in relief above the gneissic and syenitic rocks of the locality. In many cases, however, they are found luxuriating upon the polished and rounded slopes of the numerous picturesque wooded islets of granite which lie as a rule close to the precipitous rocky margin of the lake. Immediately we recede from the coast-line and reach the lofty headlands, which rise one beyond the other in the dim distance, we find that the botanical features of the whole plateau are almost identical with those of Western Ontario. The following list includes the majority of those whose occurrence on the Lakes Huron and Superior is a

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somewhat anomalous feature in their distribution, and which are absent throughout the western and southern portions of the province:—

Anemone multifida, *DC.*
Arabis petræa, *Lam.*
Draba incana, *L.*
Viola palustris, *L.*
Stellaria gracilis, *Rich.*
Sagina nodosa, *Fenzl.*
Potentilla tridentata, *Ait.*
Rubus nutkanus, *Moçino.*
Saxifraga tricuspidata, *Retz.*
Saxifraga Aizoon, *Jacq.*
Aster graminifolius, *Pursh.*
Erigeron acris, *L.*
Solidago Virgaurea, *L.*, *var.* alpina, *Bigel.*
Solidago thyrsoidea, *E. Meyer.*
Tanacetum Huronense, *Nutt.*
Gnaphalium purpureum, *L.*
Arnica mollis, *Hook.*
Cirsium Pitcheri, *Torr. and Gray.*
Cirsium undulatum, *Spreng.*
Tofieldia palustris, *Hudson.*
Allium Schœnoprasum, *L.*
Luzula parviflora *var.* melanocarpa, *Gray.*
Juncus stygius, *L.*
Carex alpina, *Swartz.* (C. Vahlii.)
Carex atrata, *L.*
Carex borealis.
Carex capillaris, *L.*
Carex Liddoni, *Boott.*
Calamagrostis Langsdorffi, *Trin.*
Calamagrostis stricta, *Trin.*
Calamagrostis lapponica, *Trin.*
Stipa Richardsonii, *Link.*
Poa alpina, *L.*
Triticum violaceum, *Hornemann.*
Avena Smithii, *T. C. Porter.*
Allosorus acrostichoides, *Spreng.*
Cystopteris montana, *Bernh.*
Woodsia hyperborea, *R. Brown.*
Vaccinium Vitis-Idæa, *L.*
Vaccinium uliginosum, *L.*
Vaccinium cæspitosum, *Michx.*
Pyrola minor, *L.*
Castilleja pallida, *Kunth.*
Euphrasia officinalis, *L.*
Rhinanthus Crista-galli, *L.*
Mertensia paniculata, *Don.*
Phacelia Franklinii, *Gray.*
Polygonum viviparum, *L.*
Rumex salicifolius, *Weinm.*
Comandra livida, *Rich.*
Empetrum nigrum, *L.*
Alnus viridis, *DC.*
Cypripedium passerinum, *Rich.*
Iris lacustris, *Nutt.*
Botrychium Lunaria, *Swartz.*
Botrychium matricariæfolium, *Al.*
Lycopodium Selago, *L.*
Rhabdoweissia fugax, *Br. and Schimp.*
Anodus Donianus, *Br. & Schimp.*
Dicranum longifolium, *Hedwig.*
Dicranum gracilescens.
Grimmia ovata, *Web. and Mohr.*
Grimmia unicolor, *Grev.*
Grimmia Donniana, *Smith.*
Pogonatum alpinum, *Brid.*
Catoscopium nigritum, *Brid.*
Tetraplodon mnioides, *Br. and Schimp.*
Tetraplodon angustatus, *Br. and Schimp.*
Hypnum molle, *Dickson.*
Hypnum Richardsonii.
Hypnum ochraceum, *Turner.*
Jungermannia minuta, *Crantz.*
Jungermannia ventricosa, *Dickson.*
Scapania sub-alpina, *Nees.*
Scapania undulata, *L.*
Cetraria islandica, *L.*

Turning attention now to the physical features of the

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southern portions of Ontario, we may characterise the whole valley—for it is really within the valley of the St Lawrence and great lakes—as a vast plain of a general uniformity of level, filled up with the detritus of the glacial drift period. These superficial deposits are clays, gravels, and sands, partly of lacustrine and partly of marine formation. Their greatest volume consists of two divisions of stratified clay, the lower of which had been partially worn away before the deposition of the upper, which therefore rests unconformably upon it, adapting itself to the irregularities of its denuded surface. The uppermost has been denominated the Saugeen, and the lower the Erie clay, the latter attaining a thickness ranging from 100 to 200 feet. The Saugeen division—the one, botanically considered, with which we have most to do—is a thinly bedded brown calcareous clay, generally containing but few boulders or pebbles. This is topped with local deposits of gravel and sand; the most important areas being the so-called *Artemisia* gravel beds, and the extensive sand belt denominated the *Algoma*. It is upon these derivative beds of clay, gravel, and sand that we find the home of our typical provincial flora; and here, too, do our visitors from the south find a suitable habitat. Attracted northward by the climatological influences exerted by our chain of great lakes, many characteristically southern species find suitable locations in Western Ontario, and thus testify to the fact that in the northern and western portions of this province we have a commingling of boreal and austral species on a scale more unique than in any other district of British America. Our great lakes, by reason of their great extent, and the consequent amount of evaporation from their surfaces, cannot fail to exert an equalising effect upon the temperature of the atmosphere over the whole peninsula, and more especially of those regions contiguous to the coast lines. The general direction of the winds being from the west and north-west, they reach the western shores of St Clair, Huron, and Superior, hot in summer and cold in winter, exhibiting the extreme character of the climate of the great continental surface over which they sweep. They arrive on the western portions of the province, however, with their temperature equalised by the great mass of waters over which they have passed. As a consequence, this

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western peninsula is remarkable for the equable character of its climate, and its adaptability for the successful cultivation of the vine and peach *sub Jove frigido.*

Lakes Superior and Huron stand 600 and 578 feet respectively above tide water, whilst Ontario sinks to the level of about 232 feet, the amount of descent being nearly 368 feet. The intervening peninsula keeps a pretty uniform level of about 1000 feet above the sea, reaching in the upper waters of the Grand River a summit-level of 1430 feet. Eastward from this point towards the Ottawa valley the country keeps gradually sinking until it attains an average horizontality of 250 feet. It is especially within the south-western area of peninsular Ontario that we discover the more prominent features of an austral immigration, and find that the flora generally approaches very closely to that of the western part of New York State. The majority of such types are given in the following list:—

Aquilegia brevistylis, *Hook.*
Nasturtium palustre, *DC.*, *var.* hispidum, *Gray.*
Cardamine rotundifolia, *Mx.*
Lepidium ruderale, *L.*
Viola palmata, *L.*
Silene virginica, *L.*
Cerastium oblongifolium, *Torrey.*
Mollugo verticillata, *L.*
Malva moschata, *L.*
Hibiscus Moscheutos, *L.*
Rhus copallina, *L.*
Rhus aromatica, *Ait.*
Floerkea proserpinacoides, *Willd.*
Euonymus atropurpureus, *Jacq.*
Euonymus americana, *L.*, *var.* obovata, *Gray.*
Acer saccharinum, *Wang.*, *var.* nigrum, *Gray.*
Polygala Nuttallii, *Torrey & Gray.*
Polygala sanguinea, *L.*
Polygala verticillata, *L.*
Trifolium reflexum, *L.*
Desmodium pauciflorum, *DC.*
Desmodium cuspidatum, *Tor. and Gray.*
Desmodium Dillenii, *Darlingt.*
Desmodium canescens, *DC.*
Lespedeza violacea, *Pers.*
Baptisia alba, *R. Brown.*
Baptisia tinctoria, *R. Brown.*
Gillenia trifoliata, *Moench.*
Geum vernum, *Torrey and Gray.*
Rosa setigera, *Michx.*
Pyrus coronaria, *L.*
Œnothera glauca, *Michx.*
Lythrum alatum, *Pursh.*
Heuchera americana, *L.*
Archemora rigida, *DC.*
Thaspium barbinode, *Nutt.*
Sium latifolium, *L.*
Erigenia bulbosa, *Nutt.*
Viburnum dentatum, *L.*
Galium pilosum, *Ait.*
Oldenlandia purpurea, *Gray*, *var.* longifolia, *Gray.*
Valeriana edulis, *Nutt.*
Fedia radiata, *Michx.*
Vernonia fasciculata, *Michx.*
Mikania scandens, *L.*
Liatris scariosa, *Willd.*
Liatris spicata, *Willd*
Aster cyaneus, *Hoffm*
Aster ericoides, *L.*

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Aster dumosus, *L.*
Aster Novi-Belgii, *Nutt.*
Boltonia glastifolia, *L'Her.*
Solidago rigida, *L.*
Solidago patula, *Muhl.*
Silphium perfoliatum, *L.*
Silphium terebinthinaceum, *L.*
Heliopsis lævis, *Pers.*
Lepachys pinnata, *Torrey and Gray.*
Coreopsis trichosperma, *Michx.*
Coreopsis discoidea, *Torrey and Gray.*
Artemisia caudata, *Michx.*
Cirsium altissimum, *Spreng.*
Hieracium Gronovii, *L.*
Phlox pilosa, *L.*
Cuscuta compacta, *Juss.*
Mulgedium floridanum, *DC.*
Lobelia puberula, *Michx.*
Rhododendron maximum, *L.*
Chimaphila maculata, *Pursh.*
Plantago cordata, *Lam.*
Lysimachia lanceolata, *Walt.*
Mimulus Jamesii, *Torrey.*
Gerardia tenuifolia, *Vahl.*
Gerardia pedicularia, *L.*
Linaria canadensis, *Spreng.*
Pedicularis lanceolata, *Michx.*
Pycnanthemum lanceolatum, *Pursh.*
Monarda didyma, *L.*
Onosmodium carolinianum, *DC.*
Lithospermum latifolium, *Michx.*
Hydrophyllum appendiculatum, *Michx.*

RANUNCULACEÆ.

Anemone, *L.; DC.* Syst. i. p. 188.

Anemone cylindrica, *Gray*, in Ann. Lyc. New York, iii. p. 221.

Plant silky-pubescent, from 1–2 feet high. Radical leaves, long-petioled, ternately divided, segments cuneate, the lateral ones two-parted, the intermediate one 3-cleft, the apex of each lobe incisely toothed; leaves of the involucre with petioles about an inch long, less deeply gash-lobed and cut-toothed than those of the radical. Peduncles from 1–6 in number, 6–10 inches in length, naked, umbellate, terminated by a cylindrical head of woolly carpels about an inch in length. Sepals 5, silky, greenish-white, obtuse. Specimens are met with whose peduncles are not all naked, but one, two, or even three may have a secondary involucral whorl, situated generally about midway between the head of carpels and the base of the peduncle. This form, therefore, would seem to form a sort of connecting link between the normal type and the *A. virginiana.* It delights in dry sandy soils, pine barrens, and dry rocky thickets, thus differing entirely in habitat from *A. virginiana*, with which it is often confounded.

Distribution.—In Ontario,—near Kingston, by Prof. Geo. Lawson; near Belleville, and on the Rice Lake plains, by John Macoun; on the Detroit River, by J. Gillman, and on the sandy flats of the Rivière aux Sables (south), by John Gibson. In Quebec it has only been observed on the island of Montreal by Principal Dawson. On this continent generally it extends from Massachusetts and Rhode Island westward through Illinois to Greenhorn

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Mountains in Colorado, and northward, according to Bangean, to the valley of the Saskatchewan.

RANUNCULUS, *L.; DC.* Syst. i. p. 231.

Ranunculus abortivus, L., var. *micranthus*, Gray.

Ranunculus abortivus, *L.; var.* micranthus, *Gray*, Manual, ed. 4 and 5; R. micranthus of *Nuttall's MS.*

Hairy, low, from 3–9 inches. Root-leaves rhombic ovate, petiolate, sometimes 3-lobed or 3-cleft, but generally only crenate; lower stem-leaves pedate with a pentangular outline; upper stem-leaves in 3 deep, linear segments sessile or sub-sessile. Flowers small, yellow, on slender peduncles. Sepals with a broad membranaceous border as long as the corolla. Fruit in globose heads. This is distinguished from the specific form by the constant pubescence of the stem calyx, and petioles, and in the rhombic ovate form of its primary leaves. "From *R. ovalis* it differs in the flower being less than half as large, and also by the shorter radical leaves, with much fewer serratures."—*Nutt.*

Distribution.—This is characteristically a western form, but appears to have strayed eastward as far as the vicinity of Boston, Mass. (Sprague). In Canada it is apparently confined to the Lake Superior region, as reported by Agassiz and Macoun, the former finding it on the northern shores, the latter at the Soult Ste Marie, on the eastern coast. According to Alphonso Wood, it has been discovered as far south as Georgia, but Dr Chapman in his Flora of the Southern States makes no mention of it from this locality. It grows, however, more or less abundantly through Michigan, Illinois, and Arkansas, and apparently becomes more frequent as we proceed westward.

MYOSURUS, *Dill.; Linn.; DC.* Syst. i. p. 231.

Myosurus minimus, L.

Myosurus minimus, *L.; DC.* Prodr. i. p. 25; *Ell.* Sk. i. p. 582; Myosurus Shortii, *Raf.*, in Silliman's Journal, i. p. 379; *DC. l.c.*

A diminutive plant, remarkable for its little terete spikelet of fruit, ranging in length from 6 lines to an inch and a half. Leaves 1–3 inches long and 1–2 lines in breadth. Scape a little taller, with a single minute pale yellow flower at the top. Sepals 5, produced downwards at base below their insertions. Petals 5, with slender tubular claws. Stamens 5–20. Achenia very closely spicate on the elongated torus.

Distribution.—This rather remarkable little plant, although common in Europe, appears to be not only of rare occurrence in Canada, but also infrequent throughout this continent. It is

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without doubt indigenous to America, as the facts connected with its distribution clearly indicate. Its southern limit appears to be Louisiana, whence it spreads sparingly northward to the Bay of Quinté, in Lake Ontario, in lat. 44° north, and west of this line extends quite up to the Pacific coast. Alluvial grounds and prairie bottoms are its invariable habitats. Its only Canadian locality, so far as observation goes, is the district lying along the Bay of Quinté, in Central Ontario. From Illinois it is reported by Dr Gray, A. Wood, and others; from Kentucky, by Dr Short; from Arkansas, by Nuttall; from Georgia and Louisiana, by Dr Leavenworth; from Jordan River, Salt Lake Valley, Utah, by Sereno Watson; and from South Park, Colorado, by Hall and Harbour. Nuttall also appears to have detected it on the banks of Wahlamette, in Oregon.

BERBERIDACEÆ.

JEFFERSONIA, *Bart.* in Trans. Am. Phil. Soc. iii. p. 334.

Jeffersonia diphylla, Pers.

Jeffersonia diphylla, *Pers.; Pursh,* Fl. i. p. 268; Bot. Mag. t. 1513; J. ornata, *Bart. l. c.*; J. Bartoni, *Michaux,* Fl. 1, p. 237; Podophyllum diphyllum, *Linn.*

A low stemless perennial herb, with long-petioled, 2-parted leaves, and naked scapes, bearing a single flower, large, regular, and white. Rhizome horizontal, with a mass of matted fibres. At the top of each petiole there is a pair of half-ovate leaflets placed base to base, broader than long, ending in an obtuse point and glaucous beneath. Seeds numerous, furnished with a fleshy laciniate aril on one side. Capsule coriaceous, obovate, and opening half way round horizontally, and has therefore a persistent lid. Stigma peltate, nearly sessile. Stamens 8, with linear antlers. Petals 8, oblong. Sepals 4, petal-like, caducous.

Distribution.—Rich woodlands, on limestone rocks or calcareous soils. In Ontario,—near Napanee, Rev. A. Scott; Point Peter near Consecon, Prince Edward County, John Macoun; banks of the River Thames, near London, W. Saunders; in the United States, Tennesee, and northward, Dr Chapman; calcareous soils, New York, to the mountains of the Southern States, Torrey and Gray; Wisconsin and southward, Dr A. Gray.

NYMPHÆACEÆ.

NELUMBIUM, *Juss.;* Willd. Sp. ii. p. 1258.

Nelumbium luteum, Willd.

Nelumbium luteum, *Willd., DC.* Prodr. i. p. 113; *Turpin* in Ann. Mus. vii. p. 210, t. 11.; N. pentapetalum, *Willd.;*

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N. podophyllum, *Raf.*, Fl. Ludov.; Nymphæa Nelumbo, *Walt.*, Car. p. 155; Nymphæa pentapetala, *Walt.*; Cyamus flavicomus, *Salisb.* Am. Bor. ii. p. 45; *Pursh.*, Fl. ii. p. 398; Cyamus luteus, *Nutt.* Gen. ii. p. 5.

Large aquatic herbs with large, emersed, centrally-peltate, fleshy leaves, and 1-flowered peduncles arising from a prostrate rhizome and radicle. Rhizome creeping, in mud in depths of water from 2–6 feet. Flowers pale yellow, several times larger than those of *Nymphæa odorata*, and fragrant. Petals numerous, arranged in many rows, arising outside the disk. Stamens indefinite, in several rows. Ovaries separate, each with a complete style and stigma, becoming in fruit one-seeded nuts half sunk in the hollows of the very large torus, the seeds suspended, orthotropous, and destitute of albumen. The nuts embedded in the torus are about the size of acorns, and remarkable for the large leafy embryo. According to Nuttall, the tubers when boiled are as farinaceous as the potato, and are employed as food by the Osage, the Comanchee, and other Western Indians.

Distribution.—Only reported from one Canadian territory, namely, from the margin of the Detroit River, by Miss Douglass of Gros Isle, August 1874. United States, Sodus Bay, Lake Ontario, Dr Sartwell; Connecticut, Prof. Hitchcock; New Jersey, rare in the middle States, Dr A. Gray; Florida, near Talahassie, Dr Chapman. As suggested by Dr Gray, this plant may have been accidentally introduced into the Detroit River and Sodus Bay, Lake Ontario, by the aborigines. It grows generally near the marshy shore in shallow water, with leaves, flowers, and fruit elevated above the surface by high rigid petioles and peduncles.

NYMPHÆA, *Tourn.*; *DC.* Syst. ii. p. 49.

Nymphæa odorata, *Ait.*, *var.* minor, *Sims.*; Nymphæa minor, *DC.*, *l. c.*; Nymphæa odorata β minor, Bot. Mag. t. 1652; Nymphæa odorata β rosea, *Pursh*, *l. c.*

Plant small in all its parts. Leaves cordate-ovate, 3 to 4 inches in diameter, a little longer than broad, smooth on both sides, green above, deep red-purple beneath, with prominent radiating veins, seven of which are basal, and five form the midrib on each side; lobes approximate, frequently overlapping, rounded or often ending in a short point. Flowers diminutive and delicate, from one to two inches in length; sepals brown; petals white, or sometimes the outer tinged with pink externally, very fragrant, with the odour of honey. Ovary spherical, filled with light-coloured loosely-arilled seeds. Upper part of the peduncles and petioles villose or thick downy, and more or less pubescent below. Stipules red, longer than broad, ovate, lacerated at end, thick-membranous, with

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scarious margins. Rhizome slender, three-fourths of an inch in diameter, covered with very fine dense hairy pubescence; branching frequently, of a dingy pink colour.

Distribution.—In Ontario,—in a small lake near Marmora village, County Hastings, July 18, 1867; also at South Lake County, Peterborough, July 29, 1868 (Macoun). In the United States it appears to be confined to the cold bogs of New York State, especially characteristic of those contiguous to Lake Ontario. In the shallow mossy pools it lifts its flowers and leaves above the water by peduncles not more than a foot in length; but in deep water its habit is similar to the typical plant.

Nymphæa tuberosa, *John A. Paine, jun.*

Nymphæa tuberosa, *John A. Paine*, in Cat. Plants of Oneida Co., New York State; Nymphæa alba, *Nutt.* Gen.; Nymphæa reniformis, *DC.* Syst. *l. c.*; *Deless.* ic. ii. t. 5; *Walt.* Car.; Nelumbium reniforme, *Willd.*, sp. ii. p. 1260.

Rhizoma deeply imbedded in mud, running horizontally, sending down in clusters long cord-like roots furnished with innumerable fibrous radicles, rarely branching, three to six feet long, one to two inches thick, varying in size but not regularly interrupted, with an uneven surface, somewhat compressed, scattered with short pubescence, bearing tubers from its sides, which are slightly connected by their bases narrowed into necks only one or three lines in diameter, usually short, often half an inch in length. Tubers oval, one to three inches long, half to three-fourths of an inch thick, with a rough tubercular surface, the tubercles elevated at the back of the buds of elementary leaves, arranged in eight perpendicular series with five spiral rows in one direction and three in the other, bearing both roots and tubers when present; the tubers often in clusters from being repeatedly proliferous, sometimes occurring so frequently as to conceal the trunk, becoming separate plants when detached. Stipules in the axils of the petioles and embracing them by long lobes, shorter than broad, crescent-shaped, with thin wavy margins. Petioles and peduncles striate with nerves and crimson veins, often pubescent above in lines with long silky purple hairs. Leaves of two forms: submerged form short-petioled, thin and transparent, the lobes divaricate and forming a right angle at base; floating leaves large, from eight to eighteen inches in diameter, exactly orbicular, sometimes retuse with sides contracted becoming angular, entire or undulate margined, green with a dark centre and even above, light-green or a little yellow below, with prominent nerves, of which on each side twelve radiate from the centre and five to seven from the strong channelled midrib, sometimes having a few brown hairs along the veins and edges of the division; lobes

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approximate, parallel, or meeting in the largest forms, ending with an acute point and a sinus. Flowers two to four inches long, expanding four to seven, exhaling a slight vanilla-like fragrance at opening, but soon inodorous. Sepals four, green without, light within, as long as the flower. Petals many, the outer tinged with green externally, the inner snow-white, ob-lanceolate in outline, delicately straight veined. Anthers yellow, long with converging cells, the connective elongated into a minute red cusp. Appendages of the stigma sixteen to twenty, short, obtuse, at first ascending and lying against the filaments, soon curving over as many rays of the disk. End of the central axis short, a line or more high, convex. Capsule globose or oblate, when maturing drawn to the bottom by the spiral coiling of the peduncle. Seeds acorn-shaped, red, with the usual raphe. Arillus defective, commonly a shallow cup surrounding the base of the seed, sometimes investing it halfway, or occasionally a mere rudiment, and rarely complete.

A larger plant than the other species, equal in beauty but wanting in fragrance. From *N. odorata* var. *minor*, of course it is as remote as possible in every part. From *N. odorata* itself it differs in its peculiar tubers, great leaves, large flowers of little odour, and imperfect arils. From *N. alba* of Europe, in addition to the tubers, it is separated by a continuous stem instead of one vertical at first, leaves highly veined, slight odour of the flower, and the usually incomplete arillus. So similar, however, is it to the latter, that it seems to have been considered the same by Nuttall in the single locality he records. The root-stalks prolong themselves indefinitely, yet only short portions are vigorous supporting leaves and flowers, the old parts declining as fast as the young ends increase. The tubers, too, attain a certain size, then wait to be broken off or to be separated by decay. Their multiplication in clusters occurs only on remaining tubers; and all, if not by any cause removed, when they have reached maturity, do not grow any larger, remaining inactive until they die with the old root. But when liberated, they float about to some new bank; as soon as striking it, shooting down rootlets and sending out their already developed delicate submerged leaves, soon to be followed by others, for the surface. These tubers, somewhat resembling those of *Helianthus tuberosus* or of *Boussingaultia baselloides*, are always present, sometimes few and single, usually frequent and abundant: as many as thirty have been counted on a section of rootstalk only six inches in length. By the slightest disturbance they loosen and rise to the surface, and can be secured in place only by the greatest care in removal. The leaves would easily be recognised from others by their shape and appearance, as well as by their peculiar venation and remarkable size, largest in the bays of Lake Ontario, at Sodus Bay rivalling even those of *Nelumbium luteum;* in imitation of which, also, both

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leaves and flowers rise high above the surface on stout stems in shallow water. The flowers may truly be termed magnificent, but their odour is faint and transient. The coiling of the flower-stems in deep water is more striking and complete than in the scapes of *Vallisneria spiralis*, though not so uniform; drawing the ovaries not only under water but to the very ground; a habit that will be verified by obtaining fruit in autumn. The rhizomes of this plant are soft and pliable, composed of a cellular or pithy substance which is very astringent. Cattle devour its immense leaves, venturing far into the water for them; in like manner, the deer of the north woods come down from the hills to the lakes at night to feed on the lily-pads so abundant there.

The Water Lily of Western New York and the great lakes.—It has been found in St Lawrence river, at Alexandria Bay, Jefferson county: in Lake Ontario, filling all marshes beyond the shore for miles north-east of Oswego, where it was observed in 1861; in the bays of Wayne County, most abundant in the channels at the head of Big Sodus Bay; plentiful in Irondequoit Bay, throughout the swamps among the ends of ridges westward formed by streams setting back against bars thrown up by the waves, marshes of Charlotte in the mouth of the Genesee River, common in Round Pond, Long Pond, Cranberry Pond, and Braddock's Bay, Monroe County: in Niagara River below Buffalo, by G. W. Clinton: in the Detroit River, by J. M. Bigelow: in Western New York; farthest east in Oneida Lake, where it is abundant near its head a little west of South Bay, in marshes of *Dianthera americana* and *Scirpus lacustris;* all along the sides of Oswego River: frequent in the outlet of Owasco Lake, and occasionally in the lake itself; common in the marshes of Cayuga river and lake; Clyde River through Wayne County; at Branchport, foot of Crooked Lake, by Sartwell; in Canandaigua Lake, more abundant, however, in its old closed outlet; in Genesee River above Rochester, by Dewey.—*Paine.* Found in all the marshes along the Bay of Quinté, and in the mud flats along Lake Ontario, from Presqu'ile eastward, and is suspected by the writers to be the "Nymphæa" of Burlington Bay, as reported by Messrs Logie and Buchan. At Lakelet, Hawick Township, County Huron, Ontario, by John Gibson. Easily distinguished from *N. odorata* by its scentless flowers.

CRUCIFERÆ.

Arabis, *L.; DC.* Syst. ii. p. 214.

Arabis petræa, Lam.

Arabis petræa, *Lam.*, Dict. i. p. 221; *DC.*, Prodr. i. p. 145; *Hooker*, Fl. Bor. Am. i. p. 42; *Cham. and Schlecht.* in Linnæa, i. p. 15; Flora of N. Am. by *Torrey and Gray;*

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Dr A. Gray's Manual of Bot. of the Northern United States, ed. 5.

Stem nearly erect, sometimes branched, glabrous. Radical leaves few, petioled, incised or pinnatifid; cauline ones few, linear, entire. Petals obovate, unguiculate, rose colour or nearly white. Pods erect, spreading, shorter and less flat than in *A. lyrata*. Root perennial, multicipital, style very short or none. Cotyledons accumbent.

Distribution.—In Ontario, crevices of rocks about five miles north of Michipicoten harbour, Lake Superior, *Macoun;* Cockburn Island, Lake Huron, *Prof. R. Bell;* Canada to Arctic America and north-west coast, *Torrey and Gray;* United States, south shore of Lake Superior, *Dr Pitcher;* Willoughby Mountains, Vermont, *Horace Mann*.

ARABIS RETROFRACTA, *Graham*.

Arabis retrofracta, *Graham*, in Edin. Journal, *l. c.;* Turritis retrofracta, *Hooker*, Fl. Bor. Am. i. p. 41; Turritis patula, *Graham;* Streptanthus angustifolius, and S. virgatus, *Nutt.;* Sisymbrium reflexum, *Kell.* Proc. Calif. Acad. ii. 101, fig. 29.

Erect, more or less canescently pubescent. Leaves lanceolate, radical ones petioled, toothed, or nearly entire; the cauline sagittate, and partly clasping. Flowers spreading or reflexed, light rose-colour, or nearly white. Siliquas linear, elongated, straight, or nearly so, more or less reflexed. Seeds in two rows, margined. In the majority of specimens the flowers are light-coloured, and the pubescence stellate, though the lower stems are often hirsute. The leaves vary from all entire to all coarsely dentate, sagittate, amplexicaul, or simply clasping, broad lanceolate, or almost linear.

Distribution.—In Ontario, on the detritus of limestone and granitic rocks, near the Portage du Fort, Ottawa River, *Gibson*. Hudson's Bay to the Rocky Mountains, and North to lat. 68°, *Hooker*. United States,—frequent in Nevada and Utah, especially in the former, 4500–8000 feet altitude, *S. Watson*, in *King's Report*. Common in Colorado and California, *Porter and Coulter*.

DRABA, *L.; R. Brown*, in Hort. Review, iv. p. 91.

DRABA NEMOROSA, *L.*

Draba nemoralis, *Ehrh.; DC.* Prodr. i. p. 171; *Hook.* Fl. Bor. Am. i. p. 55. Draba lutea, *Gilib.; DC.* Prodr. i. p. 171; *Hook.* Fl. Bor. Am. i. p. 55. Draba gracilis, *Graham*, in Edin. Phil. Journal, 1828, p. 172.

Stem pubescent, branched. Leaves oval, cauline, somewhat lanceolate, more or less toothed. Racemes much elongated in fruit,

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with very long pedicels. Flowers minute, yellowish-white. Petals emarginate, small. Silicles oblong-elliptical, half the length of the pedicles. Seeds nearly 30. Whole plant slender, 8–10 inches in height.

Distribution.—In Ontario, rocks and sandy grounds. On sands at the mouth of the Michipicotin River, Lake Superior, July 1869, *Macoun.* This is undoubtedly the "Draba" found by L. Agassiz at the same place some twenty-five years ago, and is probably identical with the *Draba muralis* reported from the vicinity of Montreal by *Hooker,* Fl. Bor. Am. i. p. 56.

United States:—Fort Gratiot, Michigan, and north-westward, *Dr Gray;* on the Sierra Madre Range, at an altitude of 11,000–13000 feet above the sea, *Coulter;* frequent in the Wahsatch Mountains, Utah, 4500–8500 feet altitude, *Sereno Watson* in *King's Report;* grassy, moist places at the junction of the Wahlamette and the Oregon, *Nuttall;* in the Rocky Mountains, from Colorado to the Arctic Circle.

Draba caroliniana, *Walt.*

Draba caroliniana, *Walt.* Car. p. 174; *Ell.* Sk. ii. p. 138; *DC.* Prodr. i.; Draba hispidula, *Michaux,* Fl. ii. p. 28; *Pursh,* Fl. ii. p. 433; Arabis rotundifolia, *Raf.,* in Am. Month. Mag. ii. p. 43.

Annual or biennial; with us the young plants spring up in the fall, and flower early in the spring. Plant quite small; never more than 3 inches high; often scarcely an inch. Stems leafy and hispid at the base, naked and smooth above. Leaves roundish-ovate, entire, clustered on the lower part of the stem, very hairy. Silicles linear, from 4–8 lines long, corymbed, much longer than the pedicels, obtuse, many-seeded, and quite smooth. Flowers white, petals oblong; twice as long as the sepals. Style almost obsolete.

Like those of the Shepherd's purse (*Capsella bursa-pastoris*), the seeds of this plant germinate immediately after the heat of summer, and make all their growth before the approach of winter, except the scape-like portion which is thrown up for a few days in the spring.

Distribution.—In Ontario, detritus of limestone rocks in many places along the Bay of Quinté, Hasting's County, *Macoun;* at Amherstburg, in the extreme south-western part of the province, *Dr Maclagan.* United States,—sandy fields, Connecticut to Rhode Island, and southward along the coast to Georgia, *A. Wood;* Rhode Island, and westward to Wisconsin, *A. Gray.* A variety is reported from Missouri, Arkansas, New Mexico, Sonora, and the Salt Lake Valley, in Utah, by *Sereno Watson.*

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LEPIDIUM, *R. Brown*, in Hort. Kew, iv. p. 85.

LEPIDIUM INTERMEDIUM, *Gray*.

Annual or biennial. Stem about a foot high, round, smooth, and branching. Leaves, all with a tapering base; the upper linear or lanceolate, mostly entire; the lower ones much larger, generally incised, or even pinnatifid. Flowers white; petals conspicuous, seldom wanting, *except in western forms*. Style minute, or none. Stamens 2; pods on pedicels nearly twice as long as the pod, minutely wing-margined at the top, orbicular or oval, with a small notch at the top. Cotyledons incumbent.

Distribution.—In Ontario, indigenous in fields and dry places. North of the counties of Hastings and Northumberland; also at Picton, Prince Edward County, Little Current, Georgian Bay, Lake Huron, *Macoun*. It extends westward, in Canada, from Fort Garry to the Saskatchewan Valley, and north-west to Little Slair Lake and Peace River. In the United States it extends from Northern Michigan and Illinois, northward and westward. Western specimens from the Saskatchewan plains are *apetalous*, and approach very closely to *L. ruderale;* in fact, Dr Hooker seems to consider them identical. The plant described by Torrey and Gray in their Fl. N. Am. as the *L. ruderale*, is doubtless the apetalous form of this species. It is a question whether *L. ruderale* is really indigenous on this continent. The apetalous form has a much wider distribution than the normal plant, ranging from Hudson's Bay and the Arctic Circle to the Pacific, and southward to Illinois, and down the central ranges to New Mexico.

VIOLACEÆ.

VIOLA *L.; Gærtn.* Fr. t. 112; *Gingius* in *DC.* Prodr. i. p. 291.

VIOLA RENIFOLIA, *Gray* in Proc. Am. Acad. of Arts and Sciences, viii. 288, June 14, 1870.

"Rhizomate floribusque *V. blandæ* vel paullo majore; foliis reniformibus (adultis sæpius poll. 2-latis), utriusque cum petiolis villoso-pubescentibus; scapo pubescente. It grows in company with *V. blanda*, which it closely resembles as to the flower, but the leaves are more like those of *V. palustris;* yet they are more strictly reniform, and are conspicuously beset with pale, soft, and tender, lax hairs."

Distribution.—In cedar swamps, Northumberland County, May 24, 1860, *Macoun*. This is the only locality in Ontario from which it has been reported; yet it may not turn out to be rare when its points of difference from *V. blanda* become more generally recognised.

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VIOLA PALUSTRIS, *L.*

Viola palustris, *L.; DC.* Prodr. i. p. 294.

Whole plant smooth. Leaves reniform-cordate. Flowers small, pale-blue, on peduncles longer than the leaves, and bibracteate near the middle. Rhizome creeping, scaly. Sepals ovate, obtuse, *with very short spur.* Capsule oblong, triangular. Seeds ovate, dark-green. The flowers resemble those of *V. cucullata,* but are considerably smaller.

Distribution.—This is one of the boreal forms which have located themselves along the shores of Lake Superior, finding here all the conditions necessary for maintenance. In Ontario, bogs are the invariable habitats. One mile north of Prince Arthur's Landing, Lake Superior, July 23, 1872, *Macoun.* Dr John Bell of Montreal detected it on the north-west coast of Newfoundland a few years since. In the United States it is confined to the alpine summits of the different mountain ranges, flourishing upon the White Mountains of New Hampshire and the mountains of Colorado, Utah, Oregon, and California.

DROSERACEÆ.

DROSERA, *L.*; *Lam.* Ill. t. 220; *Gærtn.* Fr. t. 61.

Drosera linearis, Goldie.

Drosera linearis, *Goldie,* in Edin. Phil. Journal, vi. p. 325; *Hooker,* Fl. Bor. Am., i. p. 82.

Leaves linear, obtuse, about two lines wide, erect, often circinate at the point, all radical on slender petioles, about as long as the blade, which is bordered with long glandular hairs, while the petiole is entirely naked. Scapes smooth, generally longer than the leaves, from 1–5 flowered, seldom more than three inches high. Calyx glabrous, much shorter than the oval-pointed capsule. Flowers white.

Distribution.—Growing in marshy places, in large tufts, along the north-east coast of Lake Huron, in company with *D. rotundifolia* and *D. longifolia.* In the bright sun light these plants are singularly beautiful. Each hair retains at its extreme point a pearly drop of liquid, apparently the product of a glandular exudation, on which flies become fastened and finally destroyed. Goldie detected it on Lake Simcoe, which is its most eastern station. It has been observed on the south shore of Lake Superior by Dr Houghton, and Drummond found it at Gasper Lake, on the Rocky Mountains.

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CARYOPHYLLACEÆ.

STELLARIA, *L.; Torrey*, Flora, i. p. 453.

Stellaria gracilis, Richardson.

Stellaria gracilis, *Hooker*, Richardson's Appendix Frankl. Journ. p. 736; *Hook.* Fl. *l. c.*

Perennial, growing in tufts. Stems weak, glabrous and branching, about eight inches high. Leaves lanceolate, spreading, succulent, upper ones slightly ciliate-margined. Peduncle solitary, axillary or terminal, one-flowered. Pedicel generally over an inch long, spreading. Petals two-parted, slightly longer than the scarious-margined, glabrous, acute sepals. In general appearance this species resembles wide-leaved varieties of *S. borealis*, but its mode of inflorescence is quite different in detail.

Distribution.—Hudson's Bay, Cumberland House (Richardson); Pie Island, Thunder Bay, Lake Superior, growing in tufts close to the water, July 15, 1869.

LINACEÆ.

LINUM, *L.* (in part); *DC.* Prodr. i. p. 423.

Linum perenne, L.

Linum perenne, *L.*, Eng. Bot. p. 40; *Nutt.* Gen. i. p. 206; *Schiede*, in Linnæa, i. p. 71; *Hook.* Fl. Bor. Am. i. p. 106; Linum sibiricum, *L.*, *DC. l. c.*; Linum Lewisii, *Pursh.*, Fl. i. p. 210.

Perennial; whole plant glabrous. Stems from one to two feet high, virgate, branching, from ten to forty stems from the same root. Leaves alternate, linear-lanceolate, acute, becoming linear and bract-like on the branches. Flowers racemose, and nearly opposite the leaves; sepals oval, with membranaceous margins a little shorter than the globose capsule; petals retuse, bright blue in colour, nearly half an inch long, expanding fully an inch. A very beautiful plant in cultivation, remaining in bloom throughout the whole summer.

Distribution.—On dry gravelly soil. Indigenous at Marmora Lake, Peterborough County, Ont., Macoun; Canada, Mrs Percival, *vide* Hooker. Abundant throughout North America, from the Arctic Sea to Mexico, and from Manitoba to the Pacific coast.

Linum striatum, Walt.; Gray.

Linum striatum, *Walt; Gray*; Linum oppositifolium, *Englm.*

Root perennial; stems gregarious, erect or ascending from a decumbent base, slightly viscid, and with the racemose short branches striate, with a few sharp wing-like angles decurrent from the

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leaves. Leaves oblong-ovate, lanceolate, generally opposite up to the first branch, after that alternate, about twice as long as broad. Flowers scattered along the short erect branches, bright yellow, opening only in bright sunshine; sepals scarcely ovate, pointed, equalling the very short brown capsule.

Distribution.—Wet boggy ground along Lake Huron, near the Fishing Islands (Macoun). This is its only known station in Canada. It has generally been confounded with *L. virginianum*, but is well distinguished by its habitat, by its broader leaves, larger flowers, erect branches, and shorter stem. Its range in the United States is limited to the Atlantic sea-board, being reported only from New England, Virginia, and South Carolina.

Linum sulcatum, Riddell, 1836.

Linum sulcatum, *Riddell*, 1836; Linum Boottii, *Planchon*, 1848; Linum rigidum, *Pursh*, Fl. i. p. 210; *Nutt.* Gen. i. p. 206; Linum Berendieri, *Hooker*, Bot. Mag. t. 3480.

Stem strictly erect from an annual root, and with the upright or ascending branches striate-angled or grooved. Leaves linear acute, or the upper subulate, rather rigid; *a pair of dark glands in place of stipules.* Sepals ovate-lanceolate and sharp pointed, strongly 3-nerved, and, like the bracts, with rough bristly glandular margins, scarcely longer than the ovoid globose incompletely 10-celled pod. Styles united almost to the middle.—*Gray*, Manual, ed. 5.

Distribution—Ontario. Dry soils. Rice Lake plains, and near Castleton, County Northumberland; Oak Hills, Hastings County, Ont., *Macoun.* In the United States the normal form extends from Rhode Island to Illinois and south-westward, while the dwarf, glaucous variety, *L. rigidum*, is apparently confined to the western plains.

SAPINDACEÆ.

NEGUNDO, *Moench; Nutt.* Gen. i. p. 253.

Negundo aceroides, Moench.

Negundo aceroides, *Moench*, Method. p. 334; Negundo fraxinifolium, *Nutt.* Gen. i. p. 253; *DC.* Prodr. i. p. 596; *Hook.* Fl. Bor. Am. i. p. 114; Acer Negundo, *Linn.; Michx.* Fl. ii. p. 253.

A handsome tree, with a trunk a foot or more in diameter, and from 20 to 30 feet high, with irregularly spreading branches, and a smooth yellowish bark. Leaves compound, pinnately 3–5 foliate; leaflets ovate, acuminate, remotely and unequally dentate, serrated above the middle, petiolate, the terminal one the largest, all slightly pubescent. Flowers yellowish-green; stamens mostly five;

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barren flowers mostly corymbose. Fruit oblong, with large wings dilated upwards.

This is the "Sugar Maple" of Manitoba and the western prairie country, but is nowhere so abundant as to warrant the supposition that sugar in any quantity will ever be made from it.

Distribution.—In Ontario its range is very limited, only having been detected on the River Kaministiquia, about 20 miles from Prince Arthur's Landing, Lake Superior. It is, moreover, observed in some abundance along the margins of the small streams flowing into the Red River and the Saskatchewan, and seems to extend up the valley of the latter to the vicinity of the mountains. In the United States it is chiefly confined to the prairie states, but extends southward into Tennessee and North Carolina, and south-westward into Arkansas.

POLYGALACEÆ.

Polygala, *Tourn.*

Polygala Nuttallii, Torrey and Gray.

Polygala Nuttallii, *Torr. and Gray*, Fl., i. p. 670; Polygala sanguinea, *Nuttall*, not of *Linnæus; Judge Logie's* Cat. of Plants of Hamilton, Ont.; *Dr Maclagan's* Cat. of Canadian Plants; Polygala Mariana, *Pluk.* t. 437; Polygala ambigua, *Torr. and Gray*, Fl. N. Am., not of *Nutt.*

Annual; stem slender, much branched. Leaves narrowly linear, quite small. Flowers in cylindrical spikes, in short peduncles, dense; calyx wings rose-red in our plant; corolla slightly crested. The awl-shaped scaly bracts are persistent on the axis after the flowers or fruit fall off, and constitute an excellent character to distinguish this species from the closely related *P. fastigiata*, whose bracts drop off shortly after the flower or fruit. Seed very hairy; caruncle small.

Distribution.—Ontario. This plant seems to be wholly confined to the vicinity of Hamilton (Judge Logie), and the neighbourhood of Sandwich, in the extreme south-western point of Ontario (Dr Maclagan). It has also been lately detected on the American side of the Detroit River by Henry Gillman. In the United States it is found on dry sandy soil from Massachusetts to Kentucky and southward, *Gray;* Massachusetts and Rhode Island to Louisiana, *A. Wood.*

LEGUMINOSÆ.

Desmodium, *DC.*

Desmodium canescens, DC.

Desmodium canescens, *DC.* Prodr. ii. p. 328; *Beck.* Bot. p. 84; *Darlingt.* Fl. Cest. p. 145; Desmodium viridiflorum,

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DC. l. c., Excl. Syn.; Desmodium Aikenianum, *Beck. l. c.*; Hedysarum canescens, *Linn.* Sp. 1058; *Pursh*, Fl. ii. p. 482; Hedysarum viridiflorum, *Willd.* Sp. iii. p. 1192 (not of *Linn.*); *Michx.* Fl. ii. p. 71; *Pursh, l. c.*; Hedysarum scaberrimum, *Ell.* Sk. ii. p. 217.

Stem three to five feet high, striate, scabrous pubescent, especially the upper part. Leaflets ovate, acute, from two to four inches long, scabrous above, pubescent beneath. Stipules large, obliquely ovate, acuminate, three to four lines long, finely striate, ciliate, persistent. Flowers in large paniculate racemes, both terminal and axillary on the upper part of the stem. Branches densely canescent, naked, owing to the ovate ciliate bracts falling off early. Pedicels nearly half an inch long, solitary or in pairs. Calyx hairy, bilabiate, upper lip nearly entire. Corolla nearly three times as long as the calyx, purple, becoming paler in drying. Legume from 1–1½ inches long, 3–6 jointed, joints convex on the upper side, more constricted below.

Distribution.—Moist rich soil along river bottoms in the south-western portion of Ontario, *Dr Maclagan.* This is the only authentic notice we have of its occurrence in Canada. In the United States, from New England to Florida and Louisiana, *A. Wood;* West Vermont to Wisconsin, southward and westward, *A. Gray.*

LESPEDEZA, *Michaux.*

Lespedeza violacea, Pers.

Lespedeza violacea, *Pers.* Syn. ii. p. 318; *Pursh, l. c.*; Hedysarum violaceum, *Linn.* Spec. ii. p. 749; *Willd. l. c.;* Hedysarum frutescens, *Linn. l. c.;* Lespedeza violacea, *Pers.* var. divergens, *Torrey* and *Gray;* Lespedeza divergens, *Pursh.*

Stem erect or diffuse, sparingly pubescent, much branched in our specimens. Leaflets oval or oblong, obtuse, slightly mucronate, clothed with appressed pubescence beneath. Racemes axillary, sometimes shorter than the leaves, but in our specimens always longer; apetalous flowers glomerate, and nearly sessile in the axils of the leaves. Legumes minutely pubescent, with short appressed hairs, ovate, much longer than the calyx. In our specimens the flowers are on filiforum peduncles which are considerably longer than the leaves. Very few of these much exserted flowers produce fruit.

Distribution.—This is another southern form, and, as regards Ontario, has only been observed in the vicinity of Hamilton, *Judge Logie*, and at Malden, *Dr Maclagan.* Its range in the United States is very extensive, growing from the New England States to Florida and Louisiana. It is essentially a forest species, and therefore will not be found far to the westward.

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ROSACEÆ.

AGRIMONIA, *Tourn.* Inst. t. 155.

Agrimonia parviflora, Ait.

Agrimonia parviflora, *Ait.*, Kew, ed. 1, ii. p. 130; *Pursh*, Fl. i. p. 336; Agrimonia suaveolens, *Pursh. l. c.; Ell.* Sk. i. p. 636; Agrimonia Eupatoria, *Michaux*, Fl. i. p. 287.

Stem from 2–4 feet high, hirsute, with brown spreading hairs. Leaves interruptedly pinnate. Petiole very hairy. Leaflets 11–19 in number, the larger ones from 2–3 inches long, quite narrow and deeply serrate, rough above and pubescent beneath. There are generally 2–3 pairs of small pinnules between each of the larger pairs, which give to the leaves a very graceful appearance. Stipules acutely incised. Racemes virgate, many-flowered. Flowers small and yellow. Pedicels distinct, longer than the bracts. Fruit hispid, with stiff hairs. It is particularly characterised by the numerous resinous dots which are very abundant on the lower surfaces of the leaves among the hairs, and which give to the whole plant a very agreeable balsamic odour, rendering it in most intances somewhat viscous to the touch. It resembles in its foliage *A. repens*, but its leaflets are much narrower, and the flowers only half the size.

Distribution.—Woods and dry meadows. It seems to be confined to the western part of Ontario, having only been observed in the vicinity of London by W. Saunders, and at Malden in the southwest by Dr Maclagan. In the United States it extends from southwestern New York through the intervening States to the Mississippi, and westward to Iowa and Tennesee.

DRYAS, *Linn.; Lam.*, Ill. t. 443; *Gærtn.* Fr. t. 74.

Dryas Drummondii, Hooker.

Dryas Drummondii, *Hooker*, Bot. Mag. t. 2972, and Fl. Bor. Am. *l. c.;* Dryas octopetala, *Richardson*, Append. Frankl. Journ. ed. 2, p. 21.

Leaves elliptical, slightly attenuate at the base, crenate-serrate, clothed beneath, as well as the prominent veins, with a white tomentum. Sepals ovate. Flowers yellow.

Distribution.—Gravelly beds of rivers and lake margins. In Ontario, it has only been obtained from one locality, the State Islands, Lake Superior, *Prof. W. H. Ellis;* Island of Anticosti, *Pursh.;* Gaspé Peninsula, *Dr Bell;* sand bars along the Peace River, within the Rocky Mountains, *Macoun;* Rocky Mountains, *Drummond;* in the wooded country from lat. 54° N. to 64° N., and about Slave Lake to the Arctic Sea in lat. 68° N., *Richardson;* Rocky Mountains, lat. 52° N., *Bourgeau.*

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RUBUS, *Tourn.*; *Linn.* Gen. p. 254; *Lam.* Ill. t. 441.

Rubus Nutkanus, Moçino.

Rubus Nutkanus, *Moçino,* Pl. Nutk. *l. c.; Seringe* in DC. *l. c.; Lindl.* Bot. Reg. t. 1368; *Bengard,* Veg. Litcha, *l. c.,* p. 131; *Hook.* Bot. Mag. t. 3453, and Fl. Bor. Am. *l. c.; Don.* in Sweet Fl. Gard. t. 83; Rubus parviflorus, *Nuttall,* Gen. i. p. 309.

Stems from 3–6 feet high, on Lake Superior, rather slender, flexuous, slightly hirsute, with glandular hairs. Leaves 5-lobed, the lobes nearly equal, broad, unequally and coarse toothed. Stipules often adnate with the petiole, and united with each other. Peduncles few-flowered; flowers very large; petals white; sepals glandular, with very long cusps, scarcely as long as the petals. Fruit red. This species has much the appearance of *R. odoratus,* but is easily distinguished by its large white petals.

Distribution.—In Ontario, it has only been found along the shores of Lake Superior, where it often forms thickets of considerable size. Its eastern limit seems to be on the island of Michilimackinack at the head of Lake Michigan. From this point it extends westward, along both shores of Lake Superior, to Lake Shebandowan, where it disappears. It again appears, however, along the Peace River Valley in lat. 56° N., and is of frequent occurrence in the woods through the Rocky Mountains, and along the Pacific coast.

Rubus neglectus, C. H. Peck.

Rubus neglectus, 22nd Annual Report of the Regents of the University of the State of New York on the Condition of the State Cabinet of Natural History, by *C. H. Peck.*

Stems recurved, armed with numerous straight prickles; berries dark red, having a whitish bloom; calyx hispid. Stems long, recurved, when young covered with a glaucous bloom, armed with numerous rather strong straight prickles, those on the flowering branches and petioles sometimes recurved. Leaves trifoliate, the leaflets ovate-acuminate, coarsely and doubly serrate, green above, whitish-tomentose beneath, with rather prominent anastomosing veinlets, lateral ones sessile, terminal ones often unequally 2 or 3-lobed and subcordate. Flowers on ascending or erect branches, axillary and sub-corymbose, the pedicels armed with unequal slender prickles, intermingled with stiff glandular hairs; calyx hispid; fruit dark-clouded red, with a whitish tomentose bloom. Flowers in June; fruit ripe in July.

Intermediate between *R. strigosus* and *R. occidentalis.* From the former it is distinguished by its mode of growth (exactly like *R. occidentalis*), long recurved stems and stout prickles; from the

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latter by its more numerous, straight prickles, sessile lateral, leaflets and hispid calyx; from both by the colour and flavour of the berries. It grows sparingly in scrubby cleared lands, associated with its nearly allied species.

Distribution.—Indigenous. Thickets and woodlands. Near Shannonville, Hastings county, and the counties of Northumberland and Victoria; Owen Sound, on the Georgian Bay, Lake Huron (Macoun).

POTENTILLA, *L.*

Potentilla paradoxa, Nutt.

Potentilla paradoxa, *Nutt.* MSS.; Potentilla supina, *Michaux*, Fl. i. p. 304; *Hook. l. c.*, not of *Linn.*

Decumbent at the base, somewhat spreading, pubescent. Leaves pinnate; leaflets 7–9, obovate-oblong, incised, the upper ones confluent. Stipules ovate, entire; pedicel solitary, often recurved in fruit; petals obovate, about equalling the sepals; receptacle hairy; achenia striate, 2-lobed, "the lower portions filled with starch, being as large as the proper carpel."

Distribution.—As far as known, this plant has only been observed on the south-western corner of Lake Ontario, in the vicinity of the city of Hamilton, where it was found in some abundance during the summer of 1874, by J. M. Buchan. It was growing prostrate on the sand and gravel beaches along Burlington Bay. On the southern shore of the same lake, it was detected in precisely the same situation by J. A. Paine, as early as 1865. Dr Gray, in his Manual, ed. 5, seems to consider it an immigrant form from the Southern States. According to Nuttall in *Torrey and Gray*, it is found on the banks of all the great western rivers, the Ohio, Mississippi, Missouri, Wahlamette, &c.

ROSA, *Tourn.; Linn.; Lam.*, Ill. t. 440; *Lindl.* Monog. Rosar.

Rosa stricta, Lindley.

Rosa stricta, *Lindley*, Ros. p. 42, t. 7; *Seringe* in DC. *l. c.*; Rosa pendulina, *Ait.*; Rosa pendula, *Linn.*

Much branched. Stems armed with numerous setaceous, scattered, often deciduous prickles. Flowering branches mostly naked. Leaflets 7–9, oval, firm, glabrous, not shining; the petiole glandular, hispid. Stipules lanceolate, mostly glandular-ciliate. Flowers 1–3, on glabrous or glandular-hispid peduncles. Calyx-segments spreading. Fruit ovoid, pendulous.—*Lindley*, Ros. p. 42, t. 7.

Distribution.—North shore of Lake Superior, *Agassiz;* N.E. coast of Lake Superior, and from Fort Garry in Manitoba to Lac la Nun on the Athabasca, *Macoun;* plains of the Saskatchewan, *Drummond;* Whisky Island, Lake Huron, *Dr Bell.*

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PYRUS, *Linn.; Lindley* in Linn. Trans. xiii. p. 97.

Pyrus coronaria, L., *American Crab-Apple.*

Pyrus coronaria, *Linn.*, Spec. i. p. 480; *Hooker*, Bot. Mag. t. 2009; *Lindley*, Bot. Reg. t. 651; Malus coronaria, *Mill. Michx.* Fl. i. p. 292; *Michx.* Sylv. ii. p. 67.

A small tree 10–20 feet high, with spreading branches, large, rose-coloured and fragrant blossoms, and fragrant greenish fruit. The latter is as large as a small apple, hard and sour, but much esteemed for preserves. Leaves ovate, rounded at the base, incisely serrate, often sublobate, straight-veined, pubescent when young, at length smoothish on slender petioles. Petals clawed; pedicels glabrous. Fruit depressed-globose, 1–1½ inch in diameter, somewhat translucent when ripe, ripens in September.

Distribution.—In glades near London, *Saunders*; Prince's Island, Lake Medad, *Judge Logie;* Chippawa and Malden, *Dr Maclagan;* Kettle Point, Lake Huron, *Gibson.* In the United States it grows generally on the borders of woods throughout the midland, western, and southern districts; near Lake Superior, *Dr Pitcher.*

SAXIFRAGACEÆ.

PARNASSIA, *Tourn.*

Parnassia parviflora, DC.

Parnassia parviflora, *DC.* Prodr. i. p. 320; *Hook.* Fl. Bor. Am. i. p. 82; Parnassia palustris, *var. β, Wahl.*

Very slender, from 4–8 inches high. Scapes with a single bract-like leaf, extending about one-third the distance of the scape. Radical leaves ovate, attenuate into a petiole; the cauline leaf linear-oblong, sessile. Petals quite small, sessile, a little longer than the calyx. Sterile filaments, about 5 in each set, sometimes 9, seldom none. Flowers 6–10 lines in diameter. Whole plant much smaller than *P. palustris*, from which in other respects it differs considerably. The root-leaves of the latter are often heart-shaped, and never taper into a petiole; its cauline leaves, moreover, are more than half an inch wide and nearly an inch long, whilst those of *P. parviflora* are mere bracts. The flowers also of the *P. palustris* are nearly twice as large, with fewer veins.

Distribution.—Wet rocky shores of lakes and rivers. Borders of the river St Anne and the river Jacques Cartier, *Abbé Brunet;* north and east shores of Lake Superior, Red Bay, Lake Huron, Fort Edmonton, on the Saskatchewan, and at the Canon on Peace River, B. Columbia, *Macoun.* Labrador, *Butler.* Sandy banks of rivers on the Rocky Mountains, *Drummond.* In the United States: north-west shore of Lake Michigan and westward, *Gray;* White Fish Bay, Wisconsin, *H. Gillman.* Rocky Mountains of

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Colorado, *Hall* and *Harbour*. Huntington and Ruby Valleys, Nevada, and in the Wahsatch; 6000 feet altitude, *S. Watson*.

SAXIFRAGA, *Linn.*; *R. Brown*, in Parry's First Voyage, Suppl. p. 273.

Saxifraga tricuspidata, Retz.

Saxifraga tricuspidata, *Retz*, Prodr. Fl. Scand.; *Pursh*, Fl. i. p. 312; *Don.*, Saxifr. *l. c.* p. 446; *Seringe*, in DC. Prodr. iv. p. 47; *Hook.* Fl. Bor. Am. i. p. 254. Saxifraga Chamissoi, *Sternb.* Rev. Saxifr. Suppl. p. 12, t. 10.

Stems short, tufted; leaves growing in rosettes on the autumn shoots; lower ones crowded, oblong, with three very sharp teeth, the margins very slightly ciliate. Flowers few, large, somewhat corymbose at the top of the short flowering stem, which is almost naked, having only a few short bract-like leaves. Sepals thick, ovate; shorter than the oblong-ovate, yellow or whitish petals (*white* in our Cariboo specimens). Capsule ovoid, apiculate with the conical diverging styles. Stigmas somewhat capitate.

Distribution.—Growing in little tufts on moist or dry rocks, especially in mountainous regions. North shore of Lake Superior, *Agassiz*. Rocks at the Peace River canon, B. Columbia; at Stewart's Lake, Upper B. Columbia, *Macoun*. Rocky Mountains, *Bourgeau*. Arctic and Sub-arctic America, Hudson's Bay, and Lake Winipeg, lat. 50° N., *Hooker*. Unalaska, *Chamisso*. Greenland, *R. Brown*. Lately detected on the north shore of Lake Superior, within the province of Ontario, by H. Gillman.

HEUCHERA, *Linn.*; *Gærtn.* Fr. t. 177; *B. Brown*, in Richardson's Appx. Frankl. Journ. ed. 2, p. 52, t. 29.

Heuchera americana, L.

Heuchera Americana, *Linn.* Spec. i. p. 226; *Willd.* Spec. i. p. 1328; *Ell.* Sk. i. p. 327; *Torrey*, Fl. i. p. 280; *DC.* Prodr. iv. p. 51; *Darlingt.* Fl. Cest. p. 175; Heuchera cortusa, *Michaux*, Fl. i. p. 171; Heuchera viscida, *Pursh*. Fl. i. p. 187; Heuchera glauca, *Raf.*, Med. Flora, i. p. 244.

Scapes from 1½ to 3½ feet high, generally naked; sometimes with a few bracts, glandular, and often hispid, with short hairs. Leaves roundish, cordate, generally somewhat 7-lobed; lobes short and roundish, crenate-dentate; teeth mucronate, slightly hispid, with oppressed hairs above, pubescent on the veins beneath. Panicle elongated, loose, many-flowered; pedicels divaricate; bracts linear or subulate, very small; petals spatulate, about as long as the calyx, purplish, and somewhat unequal; stamens very much exserted in the fully expanded flower; root astringent, hence the common name, *Alum root*.

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Distribution.—Woods in the extreme south-west of Ontario; only detected by Dr Maclagan, but doubtless will be met with in greater abundance when the country is more carefully examined. Its range in the United States is rather extensive, growing more or less plentifully from Connecticut in the North to Alabama and Missouri in the South. It has also been met with in Wisconsin, but is of very rare occurrence. It is essentially a forest species; while its congener, *H. hispida*, seems to prefer the dry prairie country.

ONAGRACEÆ.

EPILOBIUM, *Linn.; Gærtn.* Fr. t. 31.

Epilobium paniculatum, Nutt. MSS.

Glabrous or glandular-pubescent above. Stem erect, slender, terete, dichotomous above. Leaves narrowly linear, obscurely serrulate, acute, attenuate at the base, mostly alternate and fascicled. Flowers few, terminating the spreading filiform and almost leafless branches. Calyx tube infundibuliform. Petals obcordate, nearly twice exceeding the calyx lobes. Capsules short, acute at each end, straight or slightly curved, erect or spreading. Stems from 3 inches to 3 feet high. Flowers 1–4 lines in length, light rose-colour. Capsule 2–1 inch in length. The whole plant sometimes glabrous throughout.

Distribution.—Only recorded from one station in Ontario, at Oxendon, Colpoy's Bay, Georgian Bay, Lake Huron, *Macoun.* In the United States, from Washington Territory to Sacramento Valley, and eastward to Colorado; frequent in the mountains of Nevada and in the Wahsatch; 4500–7000 feet altitude, *Sereno Watson*, in King's Report of Explorations in the 40th Parallel. Oregon, and the Straits of Du Fuco, *Dr Scoular.* Rocky Mountains, *Nuttall.*

MELASTOMACEÆ.

RHEXIA, *Linn.; R. Brown*, in Luckey's Voy, p. 436.

Rhexia virginica, L.

Rhexia virginica, *Linn.* Spec. i. p. 346; *Lam.* Ill. t. 283, f. 2; *Michaux, t. c.;* Bot. Mag. t. 968; *DC.* Prodr. iii. p. 121; Rhexia septemnervia, *Walt.* Car. p. 130.

Stem square, the angles narrowly winged, sparsely hispid. Leaves sessile, oval-lanceolate, ciliate-serrulate, acute, sparsely hispid above, and on the ribs of the lower surface. Calyx hispid, the tube above the ovary longer than the segments, Flowers large, numerous, in corymbose cymes; petals bright-purple, ovate, hispid beneath, caducous. Anthers long and prominent, crooked, golden yellow above, with a purple line beneath.

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Distribution.—Grows in wet ground. Its only known locality in Ontario is on the sandy margin of Muskoka Lake. In the United States: Massachusetts and Connecticut, near the coast, to Louisiana and Arkansas, *Torrey* and *Gray;* Wisconsin and Illinois, *Dr Gray.*

LYTHRACEÆ.

LYTHRUM, *Linn.* (partly); *Juss.* Gen. p. 332.

Lythrum alatum, Pursh.

Lythrum alatum, *Pursh.*, Fl. i. p. 334; *Nutt.* Gen. i. p. 303; Bot. Mag. t. 1812; *Ell.* Sk. i. p. 545; *DC.* Prodr. iii. p. 81; Lythrum vulneraria, *Schrank.* pl. rar. Hort. Monac. t. xxvii. fide *DC.;* Lythrum Kennedyanum, *H. B.* and *K.* Nov.Gen. fide *DC.*

Perennial. Stem and branches quadrangular, Stem 1–2 feet high, striate, the wings narrow. Leaves (of Ontario specimens) closely sessile, slightly cordate at the base, the upper ones about the length of the flowers, mostly acute; the lower ones opposite, ternately verticillate or scattered; those of the virgate branches alternate. Flowers nearly sessile, minutely bibracteolate, axillary, solitary; calyx tube 12-striate, 12-toothed, alternate teeth cornute; corolla deep violet-purple, wavy, 6-petaled; stamens 6.

Distribution.—Wet places in the vicinity of Malden, South-western Ontario, *Dr Maclagan.* In the United States: Michigan, Wisconsin, and southward, *Dr Gray;* Louisiana, Arkansas, but not in the New England States, *Torrey* and *Gray;* Texas, *Drummond.* A variable species extends into Mexico.

UMBELLIFERÆ.

ARCHEMORA, *DC.* Mem. Umb. p, 52, and Prodr. iv. p. 188.

Archemora rigida, DC.

Archemora rigida, *DC.* Prodr. iv. p. 188; *Darlingt.* Fl. Cest. p. 195; Archemora tricuspidata and denticulata, *DC.* Prodr. iv. p. 188; Sium rigidum, *Linn.* Spec. i. p. 251; Sium rigidum, tricuspidatum and denticulatum, *Ell.* Sk. i. p. 354; Sison marginatum, *Michaux,* Fl. i. p. 168; Œnanthe rigida, *Nutt.* Gen. i. p. 189; Pastinaca rigida, *Spreng.* in Schult. Syst. vi. p. 586; *Torrey,* Fl. i. p. 314.

Stem rigid, striate, smooth. Leaves pinnately divided, smooth, variable in form, and occasionally obovate, but more commonly oblong-lanceolate, entire or remotely toothed, the teeth often very large, and sometimes reduced to two near the summit, or sometimes small and scattered. Umbels 2 to 3, spreading, smooth, of many

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slender rays. Petals white. Fruit 3 lines long, with sub-equal, greenish ribs, and large purple vittæ filling the intervals. Commissure white. The variety *ambigua*, not found in Ontario, differs from the present species in its *linear, long, and narrow* leaflets. It is the *Œnanthe ambigua* of Nuttall.

Distribution.—Sandy swamps near Malden, south-western Ontario, *Dr Maclagan*. In the United States, it ranges from New Jersey and Western New York to Michigan and Illinois, and southward to Louisiana and Florida.

THASPIUM, *Nutt.* Gen. i. p. 196; *DC.* Prodr. iv. p. 153.

Thaspium barbinode, Nutt.

Thaspium barbinode, *Nutt.* Gen. i. p. 196; *DC.* Prodr. iv. p. 154; *Darlingt.* Fl. Cest. p. 192; Ligusticum barbinode, *Michx.* Fl. i. p. 167; *Pursh*, Fl. i. p. 193; Thaspia trifoliata, *Spreng.* in Schult. Syst. vi. p. 615; *Torrey*, Fl. i. p. 317.

Stem pubescent at the nodes. Lower leaves triternate, upper ones biternate and usually opposite, segments 1–2 inches long, cuneate-ovate, acute or acuminate, unequally and incisely serrate, entire towards the base. Umbels terminal, and opposite the upper leaves on peduncles 1–3 inches long. Involucre usually wanting, but sometimes 1–2 linear leaflets; involucels 3–4 leaved. Petals deep yellow. Styles nearly erect, as long as the ovary. Fruit 2–3 lines long, elliptical, sometimes with only the dorsal and marginal ribs of the carpel winged, at other times with all the ribs equally ribbed. Stem 2–3 feet high, angular and grooved, branching above.

Distribution.—Banks of rivers and streams. Along the banks of the Detroit River, Ontario side, *Dr Maclagan;* also near the River Thames, in the vicinity of London, *W. Saunders*; Chippawa, south-western Ontario, Torrey and Gray Fl. p. 616; in the United States, it ranges from western New York to Wisconsin, and southward to Florida, *Dr Chapman*.

CAPRIFOLIACEÆ.

SYMPHORICARPUS, *Dill.;* Elth. p. 371, t. 278; *DC.* Prodr. iv. p. 338.

Symphoricarpus occidentalis, R. Brown.

Symphoricarpus occidentalis, *R. Brown* in Richards. Appx. Frankl. Journ. ed. 2, p. 6; *Hook. l. c.*

Shrub 1–4 feet high. Leaves ovate, 1–3 inches long, rather obtuse, somewhat hairy above, pubescent underneath, the lower pairs with wavy margins; the petioles about ¼ of an inch long.

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Spikes dense, terminal and axillary, nodding, nearly sessile. Calyx teeth minutely ciliate. Corolla somewhat funnel-form, densely bearded inside, rather larger and more expanded than in *S. racemosus*, purplish and white. Stamens and bearded style exserted. Berries white, remaining on the plant during the autumn and winter. The *Wolf-berry* of the Canadians.

Distribution.—Wooded river banks. North shore of Lake Superior, within the confines of Ontario, *Agassiz.* Fort Gratiot, Michigan, opposite Sarnia, Ont., south shore of Lake Huron, *Dr Pitcher.* From Lake Superior westward over the plains, and through the Peace River Valley, and west of the Rocky Mountains to Quesnelle in Upper B. Columbia, *Macoun.* Saskatchewan Valley, *Drummond.* Northern Michigan, Illinois, and westward, *Gray.* Oregon, *Douglas.* Colorado, *Hall and Harton.*

LONICERA, *Linn.; Desf.* Fl. Atl. i. p. 183; *DC.* Prodr. iv. p. 330.

Lonicera parviflora, Lam., var. *Douglasii*, A. Gray.

Lonicera parviflora, *Hooker, l. c.* var. β; Lonicera parviflora, var. β, *Torrey and Gray*, Fl. N. Am. p. 7, vol. ii., pt. 1; Lonicera Douglasii, *DC., l. c.;* Caprifolium Douglasii, *Lindley* in Hort. Trans. vii. p. 244; Caprifolium parviflorum, *Richards.* Appx. Frank. Journ. ed. 2, p. 6.

Differs from the normal *parviflora* in its *greener leaves, more or less downy, or even somewhat villous-tomentose beneath*, and its *crimson or deep dull purple corolla.* Stem 6–10 feet long, trailing or twining. Leaves 2–3, or on young shoots even 4 inches long, with a slight and sparse deciduous *pubescence* underneath, the lower ones often narrowed at the base, but sessile or connate, the upper pair perfoliate. Flowers in heads of one or more approximate whorls; corolla ringent, short, glabrous externally, gibbous at the base, crimson, or deep dull purple. Stamens and styles exserted. Berries orange-coloured.

Distribution.—Rocky banks of rivers and lakes. At the top of a sandhill, Nipigon River, north shore of Lake Superior, also on sand dunes on the River Pic, north-east coast, *Macoun.* North shore of Lake Superior, *Agassiz.* Saskatchewan plains, *Douglas.* Near Fort Gratiot, Michigan, south shore of Lake Huron, *Dr Pitcher.* Limestone cliffs along the Scioto, Ohio, *Sullivant.* Northern Ohio to Wisconsin and northward, *A. Gray.*

Lonicera involucrata, Banks.

Lonicera involucrata, *Herb. Banks; Spreng.* Syst. i. p. 759; *DC.* Prodr. iv. p. 336; *Lindley,* Bot. Regist. t. 1179; *Hooker*, Fl. Bor. Am. i. p. 284; Lonicera Ledebourii,

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Eschscholtz in Mem. Acad. St Petersb. x. p. 284; *DC. l. c.; Cham. and Schlecht.* in Linnæa, iii. p. 138; *Hook. and Arnott*, Bot. Beechey, p. 143, and Supp. p. 349; Xylosteum involucratum, *Richards.* Appx. Frank. Journ. ed. 2, p. 6.

Stem 2–10 feet long, often supported. Branches distinctly 4-angled. Leaves 2–3 inches long, on petioles 2–4 lines in length, obtuse or acuminate, hirsute-pubescent beneath; peduncles shorter than the leaves, 2–3 flowered. Bracts somewhat pubescent and glandular, the exterior ovate or sub-cordate, often nearly half an inch in length, the interior broadly obovate or obcordate, at first very small, but becoming large and conspicuous in fruit. Corolla yellowish, 6–7 lines long, pubescent, glandular, and cylindraceous; the lobes short. Stamens included. Stigma generally partially exserted.

Distribution.—Damp rocky ground. North shore of Lake Superior, by *Agassiz;* 16 miles up the Kaministiquia, and along the left bank of the Pic River, Lake Superior, *Macoun;* Saskatchewan plains and wooded country from lat. 54° N. to 64° N., Rocky Mountains, and N.W. coast between 54° N. and 56° N., *Torr. and Gray;* California, *Douglas, Nuttall;* East Humboldt Mountains, Nevada, and in the Wahsatch and Uintas, 7000–9000 feet altitude, *Sereno Watson;* Mount Lincoln, Colorado, at 13,000 feet altitude, *Coulter;* and along streams in the foot-hills and among the mountains of Colorado, *Porter.*

RUBIACEÆ.

GALIUM, *Linn.; Lam.* Ill. t. 60; *Gærtn.* Fr. t. 24; *A. Richard,* Rubiac. in Mem. Soc. Hist. Nat. part v. p. 133; *Endl.* Gen. p. 522.

Galium pilosum, Ait.

Galium pilosum, *Ait.*, Kew, ed. 1, p. 145; *Pursh,* Fl. i. p. 104; *Torrey,* Fl. i. p. 167; *Darlingt.* Fl. Cest. p. 101; Galium puncticulosum β pilosum, *DC.*, Prodr. iv. p. 601; Galium purpureum, *Walt.* Car. p. 87.

Stems often 1–2 feet high, often several from the same root, ascending, hirsute on the angles, mostly simple, except the short spreading flowering branches. Leaves about three-fourths of an inch long, 4 in a whorl, oval, indistinctly veined, hirsute on both sides, and punctate with pellucid dots. Peduncles generally ditrichotomous at the extremity of the branches, each division 2–3-flowered. Flowers paniculate-cymulose. Lobes of the brownish-purple corolla acute or acuminate. Fruit very strongly hispid with white bristles.

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Distribution.—Dry woods and sterile shady soil. Vicinity of Malden, South-western Ontario, *Dr Maclagan.* In the United States, from Rhode Island and Vermont to Illinois, and southward to Louisiana and Texas.

VALERIANACEÆ.

VALERIANA, *Tourn.*; *Linn.*; *Neck.* Elem. i. p. 122; *DC.* Mem. Valer. and Prodr. iv. p. 632.

Valeriana edulis, Nutt.

Valeriana edulis, *Nutt.* MSS.; Valeriana —— nov. spec. *Sullivant*, Cat. Ohio Plants; Valeriana ciliata, *Torrey* and *Gray*, Fl. N. Am. *l. c.*; Patrinia longifolia, *Macnab* in Edin. Phil. Journ. xix.; Patrinia ceratophylla, *Hooker*, Fl. Bor. Am. i. p. 290.

Stem one to three or sometimes four feet high in fruit; sometimes leafless, very smooth, striate, simple. Root-leaves entire, spatulate-lanceolate, tapering out into a slender sheathing base, four to nine inches long, clustered; the veins somewhat parallel but reticulated; the cauline ones pinnately cleft into 3–7 lance-linear, acute segments. Both radical and cauline leaves have their margins densely and minutely ciliate. Flowers in an elongated compound panicle; corolla very short, greenish white, subconical-campanulate. Fruit ovate, compressed, 4-ribbed, crowned with the late calyx limb of 10 or 12 plumose setæ. Root fusiform, often 6–12 inches long, resembling that of the carrot both in colour and appearance, mucilaginous, bitter and aromatic to the taste. When baked or steamed in a closed vessel, these roots, apparently pernicious, become converted into an agreeable and wholesome pulp, much relished as food by the aborigines of the country.

Distribution.—Alluvial prairies and river bottoms. This interesting species has been detected in only one locality within the province, viz., the valley of the Maitland River, and within six miles of its embouchure into Lake Huron, *Gibson.* It was apparently obtained from the same district in 1834 by Mr J. MacNab. In the United States, from Ohio to Wisconsin and westward, *A. Gray.* Washington Territory, Utah, and New Mexico, Tayabe Mountains and Ruby Valley, Nevada, and in the Wahsatch, 6000 feet altitude, *Sereno Watson*, in "King's Report." Denver and Canon City, Colorado, *Dr Smith.*

COMPOSITÆ.

MIKANIA, *Willd.*; Spec. iii. p. 1452; *DC.* Prodr. v. p. 181.

Mikania scandens, Willd.

Mikania scandens, *Willd.* Spec. iii. p. 1743; *Pursh*, Fl. ii. p. 517; *Bigle.* Fl. Boston, ed. 3, p. 314; *Darlingt.* Fl.

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Cest., p. 454; Eupatorium scandens, *Linn.*; *Michaux*, Fl. ii. p. 97.

Stem glabrous, shining. Leaves cordate, repand-toothed, acuminate, the lobes divaricate, rather unequal, membranaceous, slightly scabrous or pubescent or nearly glabrous, on slender petioles. Heads in pedunculate, axillary corymbs of whitish or pink-coloured flowers. Scales of the involucre lanceolate. Achenia minutely glandular. Anthers appendiculate at the apex.

Distribution.—Moist shady places and along streams and rivers. Has only been reported by Dr Maclagan from the vicinity of Malden, south-western Ontario. It is a species of a decided Southern range, so that its appearance in Ontario is a somewhat abnormal feature in its geographical distribution. In the United States it is found from E. New England to Kentucky, and southward to Louisiana and Florida.

ASTER, *Tourn.* Inst. t. 174; *Linn.* Gen. No. 954.

Aster ericoides, Linn.

Aster ericoides, *Linn.*, Spec. ii. p. 875 (Excl. Syn. *Dill.*); Ait., Kew (ed. 1), iii. p. 202; *Willd.* Spec. iii. p. 2027; *Pursh*, Fl. ii. p. 546; *Ell.* Sk. ii. p. 348; Aster ericoides and Aster glabellus, *Nees*, Ast. p. 101; *Lindl.* in Herb. Hooker and Herb. Torrey; *DC.* Prodr. v. p. 242; Aster sparsiflorus, *Michx.* Fl. ii. p. 242; Aster tenuifolius β ericoides, *Muhl.* Cat., p. 77; Aster dumosus, *Willd.* Enum. ii. p. 880; Aster subulatus, ramosissimus, and leptophyllus, Hort. Par. (*DC.*)

Glabrous or slightly hairy, racemose compound; the simple branchlets or peduncles racemose, and mostly unilateral on the virgate spreading branches. Leaves rather rigid; the radical and lowest cauline oblanceolate or oblong spatulate, tapering into a short margined petiole, often serrate; the others linear lanceolate and linear subulate, entire, acute at each end. Scales often hemispherical, or often slightly turbinate, involucre with acute or abruptly acuminate tips terminating the broader closely appressed lower portion; the outermost subulate from a very short base. Heads usually scattered along the branches, but sometimes rather crowded, 3–4 lines in diameter. Rays 15–25, white or pale bluish-purple; the disk frequently turning reddish-purple. Achenia with a dense minute pubescence, turgid. *Torr. and Gr.*, Fl. N. A.

Distribution.—Barren soils, Bruce Peninsula, Lake Huron, Ont., *Macoun.* In the United States, from S. New England to Wisconsin and southward, *Dr Gray.*

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Aster borealis, Provancher.

Aster borealis, *Provancher*, Flori Canadienne, 1862; Aster laxifolius, *Nees*, β borealis, *Torrey* and *Gray*, Fl. N. A.; Aster laxifolius, α and β, *Lindley* in Hook. Fl. Bor.-Am. ii. p. 10; *DC.* Prodr. v. p. 236 (excl. γ carneus); Aster salicifolius, *Richards*, App. Frank. Journ. ed. 1, p. 748.

Stem strict, smooth and glabrous, or pubescent towards the summit. Leaves vary much in appearance, narrowly linear-lanceolate, elongated, with margins sometimes scabrous, or sparingly serrulate, or even often entire; the upper surface generally slightly scabrous. At times the upper leaves are found to be rather shorter than the lower. Heads solitary, or few, or somewhat crowded on the strict (often very short) branches. Involucre about the length of the disk; the scales in 2–3 series, generally somewhat equal, but sometimes decidedly unequal, lax, the summits more or less spreading or squarrose when old.

Distribution.—Peat bogs and swamps. Vicinity of Lake Burwell, Lambton County, *Gibson;* several bogs in Central and Eastern Ontario, *Macoun.* In the United States it appears only to have been observed in Oregon. Lake Huron, *Dr Pitcher.* Suskatchewan Valley, *Drummond.* Arctic America, and west to the Rocky Mountains, *Torrey* and *Gray.*

10*th June* 1875.—Sir Robert Christison, Bart., in the Chair.

The following Communications were read:—

1. *Account of some Experiments on* Dionæa Muscipula (*Venus' Fly-Trap*). By Thos. A. G. Balfour, M.D., F.R.S.E., F.R.C.P.E.*

My attention was specially directed to the subject of Dionæa, Drosera, &c., by certain articles which appeared in different journals, containing interesting accounts of what had been done in regard to these plants, and of the curious results which had been obtained. Some of these notices had an air of truth about them, while others seemed indebted for their existence rather to the vivid imagination of the

* I was much obliged to the Regius Keeper of the Garden for the opportunity of carrying on my experiments there, and I have also to acknowledge the considerate kindness of Mr M'Nab, and the valuable assistance rendered by Mr Robert Lindsay in conducting the experiments.

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writer than to careful scientific observation. The interest, however, attaching to the whole subject was such that I felt most anxious to test for myself the truth or otherwise of the observations recorded.

My observations are not complete, and though in some cases they refer to points which have been already carefully studied by others, the present paper also contains some original and independent observations, and hence may not be altogether wanting in scientific interest.

In dealing with my subject I shall regard the Venus' Fly-trap (Dionæa) as a carnivorous plant, and I feel warranted in doing so by the opinions expressed by those who have made this plant the subject of careful study. Ellis was one of those who, about a hundred years ago, brought the peculiarities of the plant under the notice of Linnæus, &c. His letter to that famous botanist gave an excellent description of the structure and functions of the leaf, erring only in one or two points, such as in believing that the fluid secreted by the leaf was a kind of nectar to allure insects towards the sensitive part of the leaf, and in attributing to the hairs the power of transfixing the body of the captured insect. His opinion, however, was that the insect was made subservient to the nourishment of the plant.

Dr Curtis seems to have been the next observer. He resided at Wilmington, North Carolina, where he had abundant opportunities of observing the plant in its native habitat. About forty years ago he gave an able and accurate account of it, and while he corrected Ellis' mistakes regarding the time when the secretion was poured out, and showed the sensitiveness of the plant to reside in the hairs, he believed with Ellis that the plant fed on the entrapped insect.

Mr Canby, about seven years ago, while living at Wilmington also, confirmed the opinion of Ellis and Curtis as to the animal diet of the Dionæa.

Mr Darwin holds a similar view, and when we know that for six or seven years this distinguished naturalist has been studying the subject, and recall his wonderful and minute powers of observation, his great practical sagacity, and the fertility of his resources in devising experiments, we must attach no ordinary importance to the researches which I trust he may soon give to the world.

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Dr Hooker has also stamped this opinion with the weight of his deservedly great name in the address which he delivered in August last to the British Association.

In speaking of the carnivorous habits of the *Dionæa Muscipula*, I shall divide the subject into the five following heads:—1. Irritability; 2. Contraction; 3. Secretion; 4. Digestion; 5. Absorption, including assimilation. It may seem unphysiological to place secretion and digestion under separate heads, but there are some who admit the existence of the former, but deny the latter; hence I treat of them separately.

1. *Irritability.*—This is a wonderful property, not confined to Dionæa, but existing in the leaves of many plants, specially of the natural order Droseraceæ, to which the Dionæa belongs; also in the Leguminosæ, especially in the common sensitive plant of our hot-houses (*Mimosa pudica*), and among the Oxalidaceæ, but in a peculiar degree in the sensitive Oxalis (*Biophytum sensitivum*). In the Dionæa, however, this irritability is, as first pointed out by Curtis, resident in six delicate hairs, which are placed three on each lobe in a triangular form, with the apex pointing downwards; each has a peculiar bulging at its attachment to the lobe. The position of these hairs is such that it is well-nigh impossible for an insect to avoid touching them while crawling over the leaf.

To test the accuracy of this opinion I took a needle and touched almost every portion of the surface both above and below, and also the marginal hairs, and no response was given; but no sooner did I apply the needle point to the top of one of the six hairs than immediate closure of the leaf followed.

In the sensitive plant this property seems to have no apparent relation to the wants of the system; in the Dionæa, however, such a relation seems to exist, for when a certain amount of animal food has been consumed, the irritability disappears, at least for a considerable time.

On July 3, 1874, at 2.30 P.M., a large bluebottle fly was placed on a large Dionæa leaf; the diet was peculiarly acceptable, and was at once secured. Twenty-four days were required for digesting it, and when the remains were removed on the 27th the hairs were stimulated repeatedly, but no signs of irritability were manifested. On July 28,

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29, 30, and on August 1, the same was tried, with a like negative result.

A similar result followed in the case of other leaves after sumptuous repasts of caterpillars and raw meat and spiders; but these will again come before us.

This irritability is also more or less influenced by sunshine and shade, though, so far as my experiments go, not in the manner that one would naturally expect.

On July 20, 1874, four plants of Dionæa were selected—two to be placed in the shade, and the other two to remain in the sunshine. Of those in sunshine, one plant had two leaves closed by irritation, and the other had three similarly dealt with. Of those in the shade, one had four leaves closed by irritation, and the other had two thus treated.

July 21, 12.30 P.M.—All act equally well on irritation; only one of the plants in the shade had not its leaves quite so open as the others.

July 22, 3 P.M.—In sunshine, all open, and respond readily and fully to irritation. In shade, one plant has two leaves half open, and the other plant has two fully open; but all respond languidly and more or less fully.

July 23, 4 P.M.—The two plants in sunshine are not quite open, but close well on irritation. The two plants in shade have their leaves scarcely half open (the lashes are touching), but they close pretty well.

I need not weary you with details, so I pass on to the record of August 1, when the plants were, in sunshine, all about half open, but closed on irritation; while in shade two were half open, but would not close by irritation of any amount. My appended note is—"The want of sun seems here to have impaired irritability."

Again, in some cases the nature of the substance applied seems to influence to a considerable extent this property of irritability. On July 16 chloroform was dropped on the sensitive hairs of a leaf of Dionæa, and it instantly closed exactly as an eyelid would have done had chloroform been applied to the eye. To test whether it was the peculiar nature of the fluid, or simply the fluid touching the hairs, that had caused the closure, another Dionæa leaf was chosen, and a large quantity of water was let fall on it, at first drop by drop, and afterwards in large quantity, but there was no

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sign of closing; but when chloroform was added, the closure ensued in two or three seconds. These plants had not been in direct sunshine.

On July 17 new experiments were made. One or two Dionæas which were in bright sunshine were held below a watering-pan, and, at first, drops of water, and then a full stream, were directed on the sensitive hairs, and the leaves closed at once. This experiment, so different in result from the last, seemed entirely owing to the direct rays of the sun in which they had been placed; for on taking another Dionæa, which had not been so exposed, we found that, in this case, no amount of water would cause its leaf to close, but the smallest amount of chloroform did so at once. Here, then, so far as the experiments go, was a distinct evidence of the irritability being in some instances dependent on the nature of the irritant. Only the other day (June 7) I saw the leaf of a Dionæa nearly full of water, in contact with all the sensitive hairs, and yet no closure had been effected, but on my touching a hair with the point of a knife immediate closure resulted.

If this be found generally true regarding water, we can see how admirably provision has been made to guard the plant against the frequent closure of its leaves after every shower, which would deprive it of many chances of a good meal. Nor does the closure of the one which had been in bright sunshine at all militate against this view, for in most instances we have the sun obscured by clouds for some time before any continuous rain begins.

Again, this property seems to exist in different degrees of intensity in different plants of Dionæa, and sometimes in different leaves of the same plant. Thus I have found that the slightest touch on the top of a hair has been followed by instant closure, while in another leaf of the same plant this effect was only obtained after touching a hair twice.

How long is this irritability retained? The period seems to vary even in different leaves of the same plant, so that it is impossible to give a definite answer. On July 7 three leaves of one plant of Dionæa were closed by irritation; they were very lively and closed at once.

July 8.—Open by 10 A.M. at least; at 3 P.M. they were again closed at once on irritation.

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July 10.—At 12 noon two leaves quite open, one leaf only half open, and closes languidly.

July 11.—One still close which was closed yesterday; the other two, which are open, responded somewhat languidly to irritation by a glass rod.

July 14.—Only closed very languidly; the other two responded better to stimulus, and closed firmly.

July 15 and 16.—One closes languidly; other two close at once vigorously.

July 20, 3.30 P.M.—All closed with slight languor.

July 21 and 23.—All closed slowly.

On July 25 the irritability is much exhausted.

From some of them remaining closed after this it was impossible to test further before August 1, when I left town.

We see from these dates that the irritability in one leaf began to show signs of diminution on the third day, and that the other two leaves did so on the day following. On the seventh day these two temporarily regained their irritability, and retained it till the eighth and ninth day, but it became again gradually impaired, till on the eighteenth day it was much exhausted.

No great importance can be attached to these experiments, as the irritation was only practised once a day, and sometimes, though rarely, once in two days.

Of the nature of this property we cannot, of course, speak, for we know of its existence only by the effect produced, viz., the contraction of the leaf; but there seems to be a co-ordinating power in connection with the irritability, for though one or more hairs on only one lobe of the leaf be irritated, both lobes will close synchronously. I shall have occasion to return to this subject under the second heading, and I now, therefore, proceed to speak of the effect of the irritability.

2. *Contraction*, or closure of the leaf and of its marginal spines or cilia.

This property of contractibility, like that of irritability, has a distinct relation to the wants of the plant. No doubt almost any substance, whether suited for food or not, will, if placed on one of the sensitive hairs, be followed by contraction; but it is only when the material so

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introduced is capable of giving nutriment to the plant that the contraction continues. This peculiarity of the contraction is exhibited in the following instances:—

On July 4, at 3 P.M., a piece of wood was placed on a large leaf of a Dionæa, which instantly grasped it. It was, however, too large to be concealed, so that the wood was seen with the marginal spines embracing it.

July 6.—At 11 A.M. the leaf is quite open. At 3 P.M., however, it was found closed, which was apparently owing to the wood being so light as to be easily knocked against the hairs by the draughts in the greenhouse. This to a certain extent vitiated the experiment.

On the same day (July 4), at 3 P.M., a piece of dry plaster which had fallen from the wall, was put on another leaf of the same plant, and it was at once caught and concealed.

July 6.—At 3 P.M the leaf was quite open, but was closed by irritation.

July 7.—At 3.30 P.M. leaf again open.

On the same day (July 4), but on the leaf of another active Dionæa, a piece of iron nail was placed, which was grasped instantly and vigorously.

July 6.—At 3 P.M. leaf quite open, but on pressing the iron against the sensitive hairs the leaf again closed.

July 7.—At 3.30 P.M. leaf quite open again.

On July 7 a piece of the leaf of a Fuchsia was placed on a Dionæa leaf, and caught by it

July 8.—At 2 P.M. leaf quite open.

For the same reason we find that when insects have lost their nutritive power (either from having been too long kept or from having been previously digested) we have a similar action on the part of the leaf.

Thus in the case of the fuschia leaf just referred to, after the Dionæa leaf had opened a fly was placed beside the piece of Fuchsia, *i.e.* on July 8, at 2 P.M.

July 10.—Leaf open; closed by irritation.

July 11.—Leaf quite open again.

July 13.—Fuchsia leaf taken away and fly alone left, and leaf closed by irritation.

July 14.—Leaf again open.

July 15.—Fly looked a very shrivelled one, so I removed

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it and put on the leaf a bluebottle fly (which had been dead for fully a week). Leaf closed by irritation.

July 16.—Leaf quite open (probably from fly being a dried up one).

July 17.—Leaf again open. On examining bluebottle fly it was found to be quite dry and brittle, and nothing could be squeezed from it. It was removed and a living fly introduced; the leaf closed and remained so till the 28th, by which time the fly was quite exhausted of its substance. Linnæus believed that it was in consequence of the struggles of the living insect that the contraction continued, and that after its death the leaf opened; but this view is erroneous, for even in this case, which at first sight might seem to favour it, the insect was dead very long before any opening of the lobes occurred.

So in the case of a fly previously digested by a Dionæa.

On July 15 a fly of this description was placed on a very healthy leaf of a Dionæa, which instantly closed by irritation by knife; the lashes also were at right angles.

July 16.—The leaf was open so far that the lashes were not touching, and the previously digested fly was removed and a freshly caught fly was put alive into the trap.

The leaf now remained quite close till the 24th, *i.e.*, for eight days, and was not entirely open till the 27th instant.

Again, we have similar instances where the leaves have contracted by the hairs being irritated without any foreign body being entrapped; we have seen examples of this under irritability, so that it is needless to cite them again, for in these cases the leaves always opened till the irritability was exhausted.

I now tried if I could deceive my friends, and so make sure that they would keep what I had offered them. I therefore, on July 7, added a tempting fly to the leaf with the plaster, which I have already instanced as refusing to remain closed on it, and secured its closure; but on July 8 I had the painful fact to record—"The marginal hairs look very red, the leaf was quite open at 6 A.M. The fly did not seem at all digested, but the small grains of lime which were near the sensitive hairs looked as if they had been wet, and had dried again."

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I mentioned also the case with the iron nail; here I was more successful with my wiles. On July 7 a dead fly was added to the iron, and though on the 8th the leaf was again open, a little coaxing got it to close. It remained so till July 20, when from the blackness of the leaf I discovered that the dose had proved fatal, and that my success in this case had been more disastrous to me than my defeat in the last one.

In some cases, however, the leaf may close and continue so, as when a fatal shock has been given to the leaf by the administration of some poisons, or by cutting across the petiole; in this latter case the leaf generally closes very slowly.

Besides chloroform, some of the substances tried which proved poisonous, probably in some cases from the quantity used being too large, and were attended with closure of leaf, were chloride of ammonium, carbonate of soda, sulphite of soda, sulphate of soda, biborate of soda, sulphate of copper.

Where chloride of strontian was used, and also sulphate of iron, the leaves remained open, though they died.

At this time I had unfortunately no posological table to guide me as to the amount to be given in a medicinal point of view, and hence the plants succumbed to the toxic effect of the amount administered.

As there was only one experiment with each substance named, no weight can be attached to the fact of closure or otherwise, but as they are facts I record them.

The full contraction is not completed at once, and hence Dr Curtis informs us that he "has liberated flies and spiders, which have sped away as fast as fear or joy could hasten them." I have done so also; but his observation as to the rate of their speed being determined solely by joy or fear requires to be qualified by the expression "remaining ability," to be in accordance with what I have seen. On July 24, at 3.30 P.M., a large spider was enclosed in a fine large leaf of Dionæa; and on July 25, at 3 P.M., on opening the leaf the spider was found alive but languid, being wet with the acid fluid. So with a fly, alive after two days' confinement: it was enclosed in a Dionæa leaf on September 29, and on opening the leaf on October 1 the fly was alive and damp, but with no great amount

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of secretion around it; on being taken out it moved about wonderfully, and in the evening seemed well, but did not attempt to fly.

The process of contraction is this: At first the lobes of the leaf approach at the upper edge, leaving a concavity inside, in which the enclosed insect is comparatively free from pressure; but some time afterwards a distinct compression of the two sides may be noticed at about an eighth of an inch below the upper edge, and ultimately one of the sides may become quite convex internally, fitting into the concavity of the opposite blade. Hence, ultimately, the creatures, if of a soft nature—such as caterpillars, centipedes, and spiders—are squeezed flat, but those with a hard external covering, *e.g.*, beetles, resist the pressure, so that the skeleton may be found retaining its natural form and size.

But the contraction of the leaf is not single but double; it is not limited to the movements of the lobes of the leaf, but is also manifested by the ciliary or marginal spines, which, when complete contraction of the lobes is effected, may be found interlocked and at right angles to the blade. After remaining thus for some time (occasionally not longer than half an hour) the marginal spines gradually rise so as to form an obtuse angle with the inner side of the lobe. In some cases the hairs never reach the right angle, but remain at the obtuse angle, more especially if the lobes close languidly.

In some instances the insect would certainly escape if it were not for the bending of the ciliary spines, which stops its progress outwards. Sometimes, however, the whole process is so slow, both in the case of lobes and spines, that these latter have not crossed before the insect reaches them, and it escapes in such cases.

July 1, 1874.—A bluebottle fly was made to walk slowly over the leaf of a fresh specimen of Dionæa without any contraction occurring; the leaf was again irritated by the fly, and now began to contract at a very slow rate, so much so indeed that part of the body of the fly was above the margin of the lobes when the ciliary hairs or spines pressed on its body; from which pressure, however, the fly soon freed itself. When the contraction of the leaf, about

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an eighth of an inch below the margin, begins, the ciliary spines gradually separate from each other and bend backwards, in consequence of the eversion or retroversion of the margins of the leaf.

How long does the contraction continue? This is very much influenced by the amount to be digested. Thus in two instances, where a fly was entrapped, the contraction was only for eleven days; where a large bluebottle fly was caught, it was twenty-four days before the leaf opened: where a caterpillar was enclosed it was twenty-one days. In another case where a fly was caught it was sixteen days. In one instance, with beef about the size of a fly, it was fifteen days, while in another similar case it was not opened on the seventeenth day. Where a plant was gorged with meat more than twenty-four days were required. The average time of contraction seems to be between two and three weeks.

Do we know anything of the nature and cause of this contraction? My excellent friend, Dr Burdon Sanderson, showed two years ago that the peculiar electrical effect, called a negative variation, which occurs when a muscle contracts, is also exhibited where contraction of the leaf of the Dionæa occurs. This observation is one of great interest, as pointing to some special analogy between the animal and vegetable worlds.

As regards the question, "How does the irritability lead to the contraction?" we must confess our ignorance. Is the impression conveyed to some central organ from which a centrifugal force is transmitted, and can any interruption to the transmission of this influence interfere with the closure of the leaf? I spoke of co-ordinating power in the closing of the two lobes; now does this reside in the hypothetical central organ, and may we, under any circumstances, have this action interfered with? Mr Darwin has stated that he can produce this condition (a kind of palsy, if I may so style it) by pricking with a sharp lancet a particular part of the plant. This observation of Mr Darwin is still more interesting than Dr Sanderson's, for it points to the possibility of even a higher analogy than his. I do not know whether the paralysed portion of the leaf was on the side which was pricked, or whether there was a

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crossing of the influence which produced it. Given on the authority of such an able and careful experimenter, we need not hesitate to accept it, though it is only right to state that I have not as yet been able to discover the point referred to. I have made punctures in different spots, but have never seen the operation followed by non-closure of one lobe.

On July 4, I pricked a Dionæa leaf near the central hair, and it closed naturally.

July 6.—Leaf open, and responded to stimulus by both lobes closing.

Only the other day I pricked with the point of a knife a portion of the midrib, almost where the petiole joins it, but no paralysis ensued.

On July 4, I also tried if I could cut off the direct transmission of the impression made on the sensitive hair, and for that purpose I performed two experiments, one on the above date and one on July 22. I first cut one leaf of Dionæa below the sensitive hair nearest the midrib, but on July 6 the leaf was open, and responded to stimulus by again closing.

July 13.—Leaf that had been incised from the front was now cut from the back, and immediately closed; the incision was made with a bistoury right through the one lobe andextended the same length as the sensitive hairs did, so as, if possible, to interpose between them and the hinge on the left side (looking from centre of plant).

July 14.—The leaf is closed, but not very firmly. The cut was extended to-day, and care was taken that the knife went quite through the left lobe without injuring the right one.

July 15.—Leaf closed; healthy look.

July 16.—Leaf partially opened towards petiolar end of leaf.

July 17.—Leaf decidedly more open at the petiolar end, at the part beyond that at which the cut terminates.

July 20.—Part still open, but has been closed by irritation.

July 23.—Open at end again.

The lobes in this case acted in harmony, and though the leaf did not open much, this seemed owing to the shock given to the plant.

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On July 22, to test whether the influence might not be transmitted from the root, I cut the midrib of the petiole quite through at about one-third of its length from the leaf; the wings of the petiole were left entire. The leaf remained open after this operation, but was closed on irritation.

July 23.—Leaf open to only half the lashes to-day.

July 24.—At 3 P.M. leaf half open, closed on irritation

It continued to do so on July 27 and August 1.

Dutrochet, in reference to the Sensitive Plant, believes that there are two kinds of cells, the one exhibiting the power of contraction and the other the power of distension, and that these are situated, though in a reverse order, at the swelling of leaflets and the pulvinus of the petiole, the contractile cells being above in the one case and below in the other, and consequently the place of irritation is, in the one case, above, and, in the other, in the pulvinus below; and as the over distension of the other kind of cells is, in his view, the immediate cause of the movement, the leaflets are forced to take an upward direction, while the petiole falls down; and he thinks that his view is confirmed by the effects of cutting the lower part of the pulvinus, which would interrupt the process on which his theory is founded.

Dr Carpenter adopts these views, and applies them to the explanation of the closing of the Dionæa leaf. But whatever we may think as to the Sensitive Plant,* it certainly seems to fail in the Dionæa; for I have in two instances cut off a considerable slice from the lower portion of the midrib and yet the leaf has closed, so that some other explanation than that of contractile and distensible cells is here necessary. Again, if we take the case of the Droseras, which are congeners of the Dionæa, we find that in *D. longifolia*, *Whitakerii*, *rotundifolia*, &c., the mode of con-

* I have tried some experiments on the upper and lower parts of the attachment of the petiole, and I must own that, though they have been far from being quite confirmatory of Dutrochet's view, there was one instance which seemed to support it: a portion of the upper part of the petiole was cut away, and some days afterwards on touching the pulvinus the petiole did not descend to the same length as the others did, though from the weakening of the base of the petiole we should have expected it to have gone down further than any of them.

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traction is just a reversal of the circinate vernation which they exhibited while being developed. Now, if this process depends on these kinds of cells, are we to believe that they can perform directly opposite functions? Or do the two sets of cells change places? Or, thirdly, are no such cells necessary to effect the evolution of the plant? Then, I ask, why should they be necessary in the other case, *i.e.*, in its contraction? Besides, in the case of Dionæa, how can the distensible cells at the lower portion of the midrib effect the closure of the marginal bristles, which are an essential part of this wonderful contrivance for entrapping insects?

No attempted explanation, of which I am aware, is satisfactory. If I might be allowed to throw out a suggestion, I should be inclined to look for the explanation of the closing rather to the spiral vessels, which are very abundant both in Dionæa and Drosera, and which from their distribution and arrangement seem to play an important part. I shall only instance the peculiar expansion of the spiral as it enters the glandular head of the hair of *Drosera dichotoma* or *binata*. We know that elasticity is an inherent property of the spiral, and that consequently it may either contract or expand according to the forces applied to it; and in the case of *Drosera binata* any shortening of the spiral would certainly cause the secreting head to bend. Of course, I do not mean to say that spirals will explain all the phenomena, but they may hold a very important place. I have spoken of the abundant spirals in Dionæa and Drosera, and I take this opportunity of expressing my appreciation of the kindness of Mr Sadler, who has given me valuable aid in investigating the microscopic structure of these plants. But to return from this digression. From the midrib of the Dionæa we have at short distances spirals passing off at right angles across the lobes and entering the interior of the spines or marginal bristles. They proceed to the very end of the spines, though we have not yet made out how they terminate there. But even this relation might help us to understand how the double closure of lobes and spines might be effected.

While we contemplate the marvellous but secret connection between the irritability and contraction, and mark

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the matchless wisdom displayed in the whole contrivance, we have the unspeakable satisfaction of knowing, and of reverently exclaiming, that "This also cometh forth from the Lord of hosts, who is wonderful in counsel and excellent in working."

3. *Secretion.*—Ellis believed that the viscous fluid secreted was a kind of nectar, to allure the insect to the sensitive part of the leaf; but this view is entirely negatived by the fact that it is not poured out till after the capture of the insect, and it sometimes does not occur till about thirty-six or forty-eight hours after that event, though it appears to me to be generally found at the end of twenty-four hours, if not sooner. Professor Dewar, who very kindly examined some of the secretion for me, informed me that it contained no sugar. Mr Darwin showed that the secretion was acid, and Professor Dewar writes me that the acid which he discovered was "formic acid, and that the secretion also contained chlorides; that it was of a viscid nature, and on keeping did not decompose to any great extent."* I feel deeply indebted to him for the very kind way in which he undertook to examine the secretion for me; and when I inform you that the produce of some twenty-four or twenty-five leaves amounted to only about 1 or 1½ drachm, you will at once see the trouble and difficulty of making an analysis in such a case, and I can only add that I feel most grateful to him for having done so.

The presence of formic acid in the secretion of Dionæa is peculiarly interesting. Of course most of you know that this acid derives its name from having been first found in ants, specially in the species *Formica rufa;* and Will has shown that the poisonous principle in certain caterpillars, especially in *Bombyx processionea*, consists of this acid, and that it occurs in a concentrated state in all the parts of this creature. It is also regarded as highly probable that the irritation caused by the stings of various insects is due to the same acid. In man it has been found in the blood and in the juices of muscles and of the spleen, also in the thymus gland. It is the principal volatile constituent of

* The name of Professor Dewar is the best guarantee for the accuracy of this analysis.

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the sweat, and has been found in the urine, and, what is specially interesting to us, in vomited matters.

But it has also been found in plants, for it occurs in Stinging Nettles, and in some species, *e.g.*, *Urtica urentissima*, the effects produced by the sting are, as the name implies, peculiarly severe. In the plants in which it is found it is generally regarded as the result of decomposition, and this seems confirmed in the case of *Pinus Abies*, by the fact that it is found in larger amount in the needles which have fallen off than in those which are dried while fresh. As might have been expected from this circumstance, the acid is also found in oil of turpentine; and when this has been kept in leaden vessels crystals of formate of lead are sometimes found.

When the fruit of *Sapindus Saponaria* and that of *Tamarindus indica* are distilled with water and sulphuric acid, formic acid is obtained as one of the products. Gorup Besanez thinks that it may be formed by oxidation of tartaric acid originally present in the fruit; and Döbereiner has actually obtained formic acid by distilling ten parts of tartaric acid with fourteen parts of binoxide of manganese and from thirty to forty-five parts of water.

Formic acid can easily be obtained from vegetable products; thus, starch and sugar when oxidised by manganese and sulphuric acid yield it. It is also got by the action of oil of vitriol on ligneous tissue, also by distilling oxalic acid with sand and glycerine, and also from carbonic acid in water, by passing through it a current of electricity. But though it might easily be formed in plants, it has not as yet been often found, and hence one of the sources of interest in this case.

Mr Andrew Murray, in an article in the "Gardeners' Chronicle" for September 1874, takes Dr Hooker to task for his views regarding the carnivorous habits of the Dionæa, and he thinks that he (Dr Hooker) has attached too great weight to the statements of Ellis. As a solution of the difficulty, he suggests two questions which seem to me very reasonable: the first is, "Is the secretion never present until after an insect has been captured?" In answer, I may say that I do not remember having seen it under other circumstances, and, as I said above, it is always some

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little time after the insect has been caught before it appears. His second question is, "Whether it is always present after an insect has been secured?" My experience is that if the plant be healthy it is always so. I am speaking of living insects. Is this fluid a real secretion, or is it merely the exudation of the juices of the plant which are distinctly acid? There can be no doubt that it is truly a secretion. Its viscid nature would itself prove that the juices must have undergone some change. But I have better evidence, for I tried whether mere pressure would cause this fluid to appear.

September 26.—At 3.50 P.M. a portion of litmus was placed on the internal surface of a leaf of Dionæa, on which a piece of flattened wood had been previously firmly pressed, and no change in colour followed. The litmus was then moistened with water and applied as before, but without any change. The moistened litmus was then placed between the two portions of leaf, and these were firmly and strongly compressed by the fingers, and yet the litmus was unchanged in colour.

What secretes it? Ellis long ago stated that the surface of the leaf was studded over with red glands, which secreted what he regarded as sweet fluid, but which we know to be of an acid nature. These glands are among the most beautiful objects in nature, their graceful symmetry, the regularity of their cells, and their lovely colour render them most attractive microscopic objects. In some leaves, however, their colour is green and not red. If beauty of form and brilliancy of colour can be appreciated by flies, then we have a sufficient object of attraction for these insects, without having recourse to Ellis' nectar. They are very numerous, being studded over the upper surface of the leaf (excepting a small strip at the base of the marginal spines), and being most abundant and in lines in the immediate neighbourhood of the sensitive hairs. They are somewhat elevated above the surface, and have a dome shape; the cells, which by their juxtaposition present a crenate margin, contain in their interior numerous red rounded cells, which seem to contain the secretion.

That Ellis was right in supposing these to be secreting glands can scarcely be doubted, if we consider their structure and the position which they occupy on the leaf

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relatively to the fluid which is poured out. But there is an argument from analogy which seems quite legitimate and conclusive, and it is this: in other genera of the same natural order, as, for example, the Droseras, we find that the secretion in their case is effected by glands of a similar colour, and there can be little doubt that these sparkling vegetable rubies have a similar ultimate design, viz., to attract the insects within the reach of the secretion, which is accomplished at once in the Drosera, but only after a time in the Dionæa.

This secretion is not poured out needlessly.

The following experiments will afford the best answer to Mr Murray's first question:—

July 4.—A piece of wood on leaf of Dionæa, a piece of lime on another leaf of same plant, and a piece of iron on yet another.

July 6.—Exactly forty-eight hours afterwards no fluid was secreted in any of these cases.

Even when a fly is shrivelled up, if the secretion be poured out in any quantity whatever it is long delayed, thus—

July 7.—Piece of fuchsia on Dionæa leaf.

July 8.—Leaf open, and a fly now added.

July 10.—Do., no secretion, closes readily.

July 13.—Fuchsia leaf with white fungus on it; this leaf and the bottom of the leaf of Dionæa are moist; fluid faintly acid.

The mere moisture, the faintly acid character, and the long delay in this particular case, establish the fact of there being no needless waste of the secretion.

But this peculiarity is also manifested in another way, so far as I have seen in one or two instances. The acid secretion, after being poured out, either changes so as to be much less acid, or the subsequent fluid poured out has only a faint acidity, while that in contact with the insect is intensely so.

Examples.—A Dionæa leaf containing a fly was open on the seventh day, and a great deal of fluid was found, specially at the distal end of the leaf, where the fly was; this was very acid, but fluid at petiolar end only feebly reddened litmus.

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What amount of secretion is poured out? This seems to vary according to the creature or substance introduced. If it is a *bonne bouche*, such as a fat spider, or a smooth caterpillar, or a fresh fly, or a piece of raw meat, the secretion seems abundant, but if a shrivelled fly be inclosed there is, as we have already seen, little or no secretion. We know the old saying about "making our teeth water," which refers to the increased secretion of saliva which is poured out when a choice morsel is before us, or placed in our mouths, or, as Frerich has shown, even when it is introduced into the stomach by a fistulous aperture, without ever being in the mouth. No doubt this also bears a relation to the amount to be digested, for a good spider is not only a tasty article of diet, but contains a large amount of material available for nutrition.

July 24.—At 3.30 P.M., a living spider of large size was inclosed in a large healthy Dionæa leaf.

July 27.—The spider was dead, and was surrounded with fluid, which forms almost a little well near the apex of the leaf. Six tubes* of secretion were withdrawn, and the remaining fluid, which was small in amount, was carefully mopped up. The first two tubes had clear fluid, but the other four had a whitish opalescent appearance (all more or less gummy to the touch), and the fluid was acid in all. The leaf was allowed to close.

July 28.—At 3.30 P.M., spider again surrounded with fluid, and five tubes of secretion were removed, which was somewhat viscid and quite acid, and only slightly opalescent. One of the lobes was unfortunately torn a little in opening it up; the leaf was treated as on the former day.

July 29.—Small amount of fluid to-day, only about a half-tubeful, quite acid, and somewhat viscid.

July 30.—No secretion to-day, either on the spider, which is quite dry, or on the lobes of the leaf.

Aug. 1.—There is a damp appearance on spider and leaf to-day, but no accumulation of fluid.

Another experiment was tried on July 25. A living spider of smaller size was put on the leaf of another plant. On July 27, at 4 P.M., it was surrounded with fluid, which

* The tubes which were employed were the medium-sized capillary ones used in vaccination.

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was all wiped away, as a whitish semi-fluid substance was found coming from the hinder part of the spider (a similar substance may have caused the opalescence in the former case also). The leaf was allowed to close.

July 28.—One tube of clear fluid was taken away to-day; it was acid. The rest was wiped up.

July 29.—Little fluid to-day; only enough to half fill a tube. It was neutral.

Aug. 1.—There was simply a dampness on spider and on sides of leaf.

Yet another experiment was made with a spider, which in this instance was a very fat one, and apparently in an interesting condition! It was entrapped on July 27, 1874, and on the 28th it was found surrounded with fluid: two tubefuls of this were removed, and the remainder was wiped off.

July 29.—The interior of the spider seems squeezed out, the fluid about it is abundant and quite acid; two and a half tubefuls were taken, which had a reddish colour from contents of spider.

July 30.—The fat spider is much broken down, and a great deal of fluid of a reddish colour (from mixing with contents of spider) was removed. Four tubefuls were taken.

Aug. 1.—Two and a half tubefuls of reddish fluid withdrawn, and the spider was left damp. This experiment, like many others, was abruptly terminated at this date, as the Scottish Alpine Botanical Club can brook no delay.

There was one circumstance which I noted on more than one occasion. It was this: that if the meat was not put well down, so as to be near the sensitive hairs, there was little or no secretion. I shall give one example. On July 1, 1874, at 3 P.M., a piece of raw beef, about the size of a bluebottle fly, was brought into contact with the hairs of a leaf of Dionæa; in this case the contraction was rather rapid, and the meat, having been slightly moved, was fixed at the part of the leaf a little below the marginal bristles or spines, and there it was found on July 3, looking dark, dry, and somewhat shrivelled. On that date, however, I pushed it down to the hinge, and, in twenty-three hours after it had been pushed down, on separating the lobes,

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the intermediate space was found very full of fluid, and the meat was pale, like veal, and partly digested.

Now, if these observations be proved to hold generally good, it would point to a beautiful relation existing between all the properties already mentioned, viz., irritability, contraction, and secretion; for we must remember that a piece of meat placed near the marginal spines is not in accordance with the natural process, which renders it necessary that the insect should be down in the neighbourhood of the hairs when it is caught, so that no insect would naturally be found in such a position as the beef was, unless the plant were very sickly and closed so slowly that the creature would have time to creep up to that position, but this would indicate in the plant a feeble or unhealthy condition, and, under such circumstances, abstinence from animal food is usually enjoined.

I come now to speak of the fourth head, which is

4. *Digestion*, or the action of the contraction and secretion in favouring the solution of the animal matter, and preparing a pulp suitable for absorption. If this effect is produced then there can be no question that true digestion has occurred, whether it be in the stomach of a man, or of a beast, or in the leaf of a plant, or in the interior of a glass vessel. No doubt it may be a more complicated process in the one case than in the other, but the essential parts of the process are alike in all; and I cannot see why Mr Murray should so strenuously oppose the use of the term digestion in the case of Dionæa. Dr Hooker, I am certain, knew well the structure and functions of the human stomach when, by way of illustration, he beautifully compared the action of the Dionæa leaf to it. Mr Murray cannot suffer this statement to pass; and he asserts that even in this Dr Hooker "will scarcely deny that, put it any way he likes, the analogy is of the feeblest." And Mr M. goes on to say, "Would it not be an anomaly in the economy of nature if a complicated apparatus should be provided to do something which is of no advantage to the plant, and which it seems to be able to do quite well without? Of course there are no flies for the Pinguicula to feed on in winter, and yet it grows as well then as in summer. For three weeks of the time I observed it we had a great

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deal of rain, and the leaves were washed free from all remains of flies, yet the plants seemed to thrive better and better. Drosera was in the same predicament, and I presume Dionæa must be so too." Now in these sentences there are two or three assumptions which it might be well to notice; the first is that "the process is of no use to the plant." He is referring to Pinguicula, but from his concluding sentence, he seems to include Dionæa also. On what grounds does he rest this opinion? Mr Lindsay, a very intelligent and careful observer, informed me that when young plants of Dionæa were grown under bell-jars they found that they never throve so well as those which were left free. As regards his remarks about the rain washing off the remains of flies, he seems to forget that where there were "remains" the substance must have gone to feed the plant; and if not entirely gone, the rains which swept them away must have favoured their decay and brought them in contact with the roots of the plants, and thus have contributed to the nourishment, for no one, so far as I know, ever asserted that the leaf was the only medium through which the Dionæa was supplied. Surely Mr Murray must know that though there is such admirable provision in the human mouth, stomach, &c., for receiving food for the nourishment of the body, yet the skin may absorb nutriment, as in the case of baths of milk, but who would assert that the fact of the one doing so precludes the action of the other?

Again, Mr Murray says, "The entrapped insects do melt away under the influence of the secretion, but no more, I apprehend, than they would do under the influence of any other feeble acid. Now, the secretion is slightly acid; not quite so much as the juices of the plant itself, but still slightly so. The juices of most plants are acid." . . . ." It is not an unnatural assumption that the secretion exuded will participate more or less (less rather than more) in its acidity; and so it does." He then, in reference to the acid juices of plants, exclaims, "Here is a means of dissolution which is applied universally to assist decay; but something more is needed to make digestion. If you apply the litmus paper to the moist or half-rotten leaves of Sphagnum or Polytrichum you will find them much more

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acid than the Pinguicula; but no one will consequently propose to endow them with digestive powers." And, after other remarks, he concludes thus, "I do not believe that had this question not been complicated by the curious machinery of Dionæa, for which it is so difficult to find a purpose, that we should ever have heard of carnivorous plants or digesting vegetables." This argument, if carried out, would apply equally to the acid secretion of the stomachs of men and of the lower animals; for, stated in the broad and general way in which he has put it, we might explain that, as acid is the general agent of decay throughout all nature, we cannot believe that we should ever have heard of carnivorous beasts or digesting animals if it had not been for the curious machinery found in their bodies. And had we only lived before the structure and functions of the stomach had been so thoroughly investigated we might have boldly asserted that no true digestion did take place in that organ, but only a process similar to that which we see around us, whether in the *kitchen* or in the *mill*, or throughout *all nature;* and we might have fortified our position by an appeal to most eminent authorities, for Hippocrates held that digestion was merely a *cooking* process; while Borelli, Boerhaave, and others regarded it as a mere *mechanical trituration;* while Plistonicus held that it was simply a *putrefaction.*

But surely, after all, there is a decided difference between the juice of a plant and its secretion. In the Dionæa I grant that the acid character is of about equal intensity in both. In the *Drosera dichotoma*, however, it is far otherwise, for while the juice is quite acid, the drops of secretion are scarcely, if at all, so. But in both Dionæa and Drosera we find that while the juice is thin and watery, the secretions are gummy and tenacious, which certainly indicates that a great change has been effected by the secreting cells.

Another circumstance indicating digestion is this, that putrefaction does not occur during the whole period, even when we find that the secretion has become only faintly acid. This certainly is not what we should find under ordinary circumstances. Even the Sphagnum is no exception. Mr Murray is right in saying that it is acid, but he makes a great mistake when he asserts that the disappear-

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ance of insects in the Dionæa and Drosera is simply by a process of decay caused by the acid fluid, just as in the case of the Sphagnum. On June 8, 1875, I placed a piece of raw beef in the centre of a considerable amount of Sphagnum, partly green and partly decayed, and again I placed another piece more loosely amongst the leaves of this plant; while, on the other hand, I put a similar piece of raw beef on the leaf of a Dionæa. On June 10, at 6 P.M., the first two pieces were putrid, while the piece in Dionæa had no bad smell whatever.

I could give many illustrations of this, as almost all the ordinary experiments attested it. In order, however, to prove that the mere exclusion of much air and the coolness of the leaf had nothing to do with the absence of decay, I took a piece of meat, and having selected a leaf of *Stadmannia australis* (which was in the same house with the Dionæa), on July 4, 1874, I got Mr Lindsay to tie the meat up in the leaf, which was then folded several times. On July 6 the meat had a darkish look and a putrid smell, and on wetting it with water only a very faint red was given to litmus, which indicated that ammonia, one of the earliest products of decomposition of animal matter, had been developed to such an extent as nearly to neutralise the natural acid of the beef. On July 11 the meat was very putrid and quite decayed.

But a more striking instance, inasmuch as it illustrated both processes, was this. Mr Lindsay had gorged some leaves with raw beef—so great was the quantity given that the meat projected beyond the marginal spines or bristles. This was done on July 4, 1874.

On July 6, on opening one of the leaves, it was found that, while the portion of meat beyond the marginal hairs was dark and dry, and had a faintly putrid odour, the portion contained within the leaf was white and had the appearance of having been macerated, and had no apparent putridity, but seemed quite fresh. The meat was now taken from the leaf, and the tainted portion having been cut off from the fresh portion, this latter was put under a wooden box (to keep away flies) to see if the partial digestion which it had undergone would retard decay. This was done on July 6.

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July 7.—The tainted meat cut away is much more putrid, while the partially digested meat has no smell.

Another interesting fact is, that when meat is partially decayed, if it be put amongst the secretion it will lose its smell.

On July 6, one of the gorged leaves, of which the part projecting gave a very putrid smell, had this portion pushed within the leaf, and on July 8 no putrid odour could be discovered. On opening the leaf there was much acid juice, and the meat was much whiter, but no smell was discoverable.

How is the process carried on, and what is the result?—In answer to these questions I would say, slowly but steadily; and if we select raw beef for observing the changes, we find that it soon loses its red colour, as in the instances just cited, and is gradually disintegrated more and more till ultimately the state of pulp is produced. In one instance, viz., that of a piece of raw beef, about the size of a bluebottle fly, which was introduced on July 1, it was found on July 23 reduced to the state of pulp, quite free from smell.

Ex uno disce omnes.

I have been speaking of healthy plants, in which all the functions were normally discharged; but we have pathological as well as physiological conditions to consider, and unfortunately many of these conditions are induced by imperfect digestion, owing to artifical feeding, and hence dyspepsia in different forms is not uncommon. Some articles of diet are peculiarly difficult of digestion, and ought never to be indulged in by a Dionæa: such is cheese; hard boiled albumen they can digest pretty well, but this coagulated and compressed casein they cannot manage. Mr Canby lost one of his patients among the Dionæas by ordering it a diet of cheese, and my own experience is equally painful.

On July 8, 1874, I had eleven patients under my care at one time, and to one of these a diet of cheese was prescribed. After Mr Canby's experience I felt anxious about him, and watched him carefully.

On July 9 the entry in my note-book is—"Leaf healthy and quite closed except at farthest point, where it is open

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about one-eighth of an inch, and lets out a clear acid fluid smelling of cheese." This vomiting evidently indicated considerable irritation, and the smell of cheese which attended the ejected fluid showed clearly that that substance had not yet been digested. However, as he had a healthy look and a firm grasp, I was not so alarmed.

My next note is a short one, on July 10, 12 noon:—"Leaf closed, not injured." The vomiting had apparently ceased, which, with the general appearance, was re-assuring.

July 11, 3 P.M.—Much the same as yesterday.

At 4 P.M., on July 13, he was still quite healthy and firmly closed.

July 14.—Much as previously.

On July 15 I had so little time that I scarcely saw my patient.

July 16 contains notes of the other patients, but his case is omitted, probably from being much *in statu quo*.

On July 18, 4.15 P.M., the short notice is, "Cheese closed," which means that he had still considerable muscular power remaining.

July 20, 3.30 P.M.—Same note.

But on July 21 my alarm was excited, for though the muscular power was good, yet biliary disturbance was indicated, for the note is to the following effect:—"Still closed, but yellowish on blades, and two lashes of a dark colour." These symptoms were unmistakably serious, and, as I suppose I had formed the worst prognosis of the case, I had prudently withdrawn. I find no further attendance marked. This was on the thirteenth day.

Nothing is more injurious than overloading the stomach, and hence the common advice is, "Not to cram like John Bull." I had generally been very particular in the amount which I had prescribed, but on one occasion after I had left, Mr Lindsay had, in defiance of all proper dietetic rules, gorged four fine healthy Dionæa leaves to such an extent that on the following day, July 6, I was horrified at finding some of the beef sticking out of the mouths of three of them. In the case of one of these I promptly applied a remedy by pulling the meat out of its throat by my fingers, and thus saving it from threatened suffocation—the mouth

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immediately closed, and all danger was at an end, as I find on July 13 the note—"Leaf still closed by the lashes crossing, but the lobes are slightly separated."

On that date, however, a nasty jaundiced appearance manifested itself in the other three patients, who had been left to retain the excessive amount of beef. Digestion in their cases was very seriously impaired, as offensive eructations testified.

I shall give the notes. July 13.—The three surfeited ones are quite closed (this is now the ninth day after the gorging), but have a dingy yellow and unhealthy look, which applies also to the upper part of the petiole. On opening one of them the meat is about one-eighth of an inch from the edges, and fluid abounds which has now only a faint acid re-action; but there is a slightly tainted smell about the meat, which seems to be considerably digested.

On opening another leaf, the meat seemed less digested, but it was lower down, and there was scarcely any preceptible smell. Fluid here was also faintly acid. On the blades of these two leaves there are slight darkish-brown discolorations on the outsides.

On opening the third leaf a part of the meat was dark and projecting between the margins. Here there was a more putrid smell. The fluid was faintly acid. This leaf has a shrivelled look outside, and also a slight discoloration here and there on the blade.

I have continuous notes to July 28, which I need not give *in extenso;* suffice it to say that one of them was in a pitiable condition, and was executed on the 24th. One of the remaining two had by that date recovered wonderfully, the whole meat having been dissolved, and his breath being quite sweet; while the other had only partially recovered, there being still a faint smell like that of old meat perceptible in his breath.

July 28 has the note "As before."

The capacity of their stomachs is not large, two flies being apparently sufficient to satisfy them, if given in succession; but a surfeit is extremely dangerous, for, though they may sometimes escape a fatal issue, they may suffer long and severely from stomach complaint.

All their diseases, however, are not owing to improper

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diet, but when the general health is impaired the secretion is not poured out in sufficient amount to digest the food, as the following example will show:—A yellowish-looking leaf, which, if we had been living in the days when the doctrine of signatures was prevalent, would certainly have been prescribed as an infallible cure to any one suffering from hepatic derangement; this leaf, I say, was selected, and a small beetle enclosed within it. On opening it afterwards the leaf was found dry, and so was the beetle, but on pressing the beetle slightly a good deal of fluid was forced out of it, indicating that in consequence of the ill-health of the leaf there had been no power of secreting fluid, and hence the contents of the beetle had not been removed.

Amount capable of being digested.—As I have already said, two good flies or two good spiders seem to be all that the Dionæa leaf can, at least for some time, digest with comfort to itself. Now, if we multiply thes e by the number of the leaves, we shall find the amount of food which, by its foliar stomach, a plant of Dionæa can digest. The leaves are, on an average, about six to each plant, so that if all the leaves were equally successful in their capture we should have a dozen of flies as the amount of food devoured by the leaves.

I shall give an example of how much one leaf digested. On June 30, 1874, a Dionæa with four or five leaves, within one of which, at least, a fly had previously been enclosed, was chosen, and on a fresh leaf a spider of good size was made to crawl and was immediately entrapped. On July 13 the remains of the spider were removed, and seemed to be a mere shell. On placing these under the microscope the legs seemed nearly transparent; there was one portion opaque and dark, but on pressing it firmly nothing came out. On this, the thirteenth day, another spider was placed on the same leaf, and was somewhat languidly entrapped. On August 1, the leaf was almost open (*i.e.*, on the nineteenth day), and the remains of the spider, which were of small amount, were removed, and now it was found that the leaf would not close on irritation by another spider, or by the blade of a knife, or by touching it with the finger.

5. *Absorption, including Assimilation.*—Duchartre objected

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to this idea of absorption on the ground that it was not in accordance with our knowledge of the functions of leaves, and to the whole course of the nutrition of vegetables, and therefore was not to be seriously entertained. This argument reminds one of the miserably fallacious arguments against miracles by Hume. It is in both cases a mere *petitio principii*. All plants are not constituted like the Dionæa, and if it has such a peculiarity in structure, why should it not have a similar one in function?

Other objectors may say, True, the insect is digested and reduced to a semi-fluid pulp, but this is simply for the purpose of allowing it to run down the channelled petiole, and so of reaching the absorbent roots of the plant. Mr Canby at one time thought that such was the case, but he afterwards discovered his mistake.

Two answers may be given to the above objection.

1. In a healthy Dionæa, where the natural food of the plant has been taken and in the normal amount, no fluid does run down the petiole. Three flies were placed on three leaves of Dionæa, and pieces of litmus were attached to the petioles on Sept. 26; and on Sept. 28, at 4 P.M., the litmus was not in the least degree reddened. On Sept. 29 the same, and so on Oct. 1 and Oct. 3, and yet on this latter date one of the leaves was opened, and a considerable quantity of fluid of an acid nature was found. This was on the seventh day.

2. The second is that the leaf is found quite dry on the surface, with only the slightest indication, if even that, of remains, and if we open the leaf from time to time we can see the process of change going on, and the gradual diminution of the amount.

Example, piece of raw meat on leaf of Dionæa on July 1. On July 18 there seemed very little difference on the external appearance from what had been noticed on the 4th, when it was pale, like veal, and partially digested; but on the 23d the beef was found in a soft thin pulp and in small bulk. On the 24th almost all gone, and on the 25th small thin dry flakes are all that remain.

In this case the whole process of digestion and absorption took twenty-four days, but the absorption seemed to go on at a much more rapid rate towards the end.

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The first answer proves that there was no escape from the leaf, and the second declares that after a certain time nothing, or next to nothing, was found in the leaf; and if these considerations do not shut us up to the conclusion that absorption had taken place, I fear we must have an equally great difficulty in establishing the fact of absorption by the roots of plants or by the lacteals and lymphatics of animals.

I understand that some one has asserted that the disappearance of the food is not owing to absorption, but to its being devoured by Bacteria and Vibrios. Well, if these be, as Professor Lister supposes, vegetable and not animal bodies, we may as well believe in the digestion and absorption by the larger plants as by the smaller ones; but we must remember that these minute bodies are now generally regarded as the cause of decomposition, with its attendant noxious gases, but, as we have seen in a normal case of digestion in the Dionæa, we have none of these present.

How is absorption effected? I cannot as yet say. I tried the following experiment to discover it, but I failed, in consequence of the vital elective power of the absorbent cells or vessels. On July 16, 1874, I put insects and beef, which I had stained red or blue by steeping them in a solution of cochineal or in one of sulphate of indigo, and I hoped that by the colours in the cells I might be able to trace the course of the absorbed material; but these colours were pressed out from between the leaves, and entirely disappointed my expectations. On examining the surface of the leaf of a Dionæa you find two sets of stomata, the one set presenting the usual appearance, with two or four cells surrounding the opening. These are found on both sides of the leaf, though, as is usually the case, much more abundantly on the lower side than on the upper. The other set are of a brownish colour, and are peculiar, inasmuch as, in addition to the central cells, there are from five to eight peristomatic cells, which are of such delicate structure that they fold upon themselves with the utmost ease. These seem confined to the lower side of the leaf. Bearing in mind, then, these two kinds of stomata, let us next direct our attention again to the beautiful red glands to which we referred in speaking

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of secretion, and if we examine them very carefully by the microscope we occasionally see in the centre of the cells, and apparently connected with them, bodies presenting an appearance not unlike stomata, and it has struck me that probably these are the mouths of absorbent ducts. When we consider the double supply of stomata which this plant possesses, we can hardly doubt that all the ordinary functions of such organs are well discharged by them; and is it not reasonable to suppose that these other bodies, placed in the immediate vicinity of the pulp formed by the contents of the secreting cells, are intended for absorbing that substance, and so rendering it available for the nutrition of the plant?

II. *Additional Experiments on* Dionæa Muscipula.*

Since I wrote the foregoing paper, our esteemed President, Sir Robert Christison, was good enough to suggest that I might try the effect of pepper on *Dionæa Muscipula*, and see whether or not the same kind of secretion was poured out under its influence as when animal food was administered; and, at the same time, he alluded to the interesting experiments of Tiedemann and Gmelin, which showed that, while with other condiments a mucous secretion was alone poured out, when pepper was employed the true gastric juice was secreted by the stomach.

I had much pleasure in complying with this interesting suggestion, though, in consequence of other engagements, I regret that I can only as yet record one of my experiments with that agent.

On June 24th 1875, at 4 P.M., two leaves of Dionæa were selected, and a small piece of white pepper was placed on the one leaf, while a similar piece of black pepper was placed on the other.

June 25.—The leaf with the white pepper is open, and the pepper is lying on the moss below. That with the black pepper is quite closed. On opening the leaf it is found moist inside, and the fluid gives an acid reaction with litmus. A very minute fly is, however, also found inside the leaf. This last circumstance may in the eyes of some

* Read 8th July 1875.

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be regarded as vitiating the whole experiment; but, as it was at once removed, and could only have been in for a short time, and that at the very beginning of the process, I am not inclined to regard it as influencing the result.

June 26.—The leaf with the black pepper is firmly closed, and, on being opened, is found wet with acid fluid. The other leaf, to which the white pepper had been again added, is quite open.

June 28.—Same as at last report on the 26th.

June 29.—Leaf with black pepper is still firmly compressed. The other leaf had now a portion of pimento added instead of white pepper.

July 1.—Leaf open; allspice lying on moss below.

July 3.—The leaf with black pepper continues quite close, but a light brown colour is observed at one end of the leaf. The contained fluid still reddens litmus. The other leaf had had a piece of black pepper substituted for the allspice, and to-day it is found partially opened, but no fluid is inside.

July 5.—The original leaf with black pepper is still closed, and the edges are everted.

July 6.—Same as yesterday.

I trust that, on a future occasion, I may be able to lay before the Society a sufficient number of facts to enable us to come to a satisfactory conclusion on this subject, as some of the experiments are still going on, and others will be instituted. Meanwhile, if we can ignore any influence from the short presence of the unwelcome little fly, we may, so far as the present experiment goes, conclude that black pepper acts on the leaf of a Dionæa in a way similar to that in which meat and insects do.

Sensitive Hairs cut off.

June 29, 1875.—Six sensitive hairs cut off.

June 30.—Lobes closed.

July 1.—Leaf open, and will not close on irritation.

July 2.—Leaf open, but closed slowly on irritation being applied to part where hairs had been.

July 3.—Lest some portions of hairs might have been

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left, every possible trace was most carefully removed, yet the leaf closed slowly.

July 5.—Fine sunshine to-day. Leaf open, and looks quite healthy and natural *minus* the hairs; irritation, though repeated several times over the part where the hairs used to be, will not cause the leaf to close.

July 7.—Quite open to-day, but closes easily on irritation of the part where hairs had been.

Another experiment.—On July 3d another leaf had five sensitive hairs (which were all that it had) cut off by a sharp bistoury. When the fingers which kept it open during the operation were removed, the lobes seemed at first to remain open, but very gradually closed in a most peculiar way. Thus the right lobe moved very little, and was *concave externally*, the left lobe moved across the middle line, and by its external convexity allowed the other lobe to fit into it; but, in consequence of thus stretching over, it was not able to reach with its edge the level of the edge of the right one, and its spines are as nearly as they can be at right angles, while the spines of the right side are nearly erect.

July 5.—The leaf is close at both ends up to near where spines begin. The leaf has same appearance as on 3d inst., the convexity of the one internally fitting into the internal concavity of the other (left side). The leaf is partially open along the spines, and it seems more open in the very middle, in consequence of the left lobe bulging out more at that part than at either end. The spines on the right lobe are nearly erect, while those on the left bend over. There is a small amount of fluid at the bottom on midrib, and on applying litmus it was found to be very faintly acid. This acid fluid may have exuded from the slightly *injured* leaf, and may have been the mere juice of the plant.

July 6.—Similar to-day, but a little more open, and is quite unaffected by all attempts to close it by irritation. Both to-day and yesterday there was fine sunshine and also heat.

July 7.—The leaf was open as it was yesterday, but by a good rub with a pencil it nearly closes. It presents the same appearance of erectness of spines on right lobe, and of bending over of those on left lobe.

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Another experiment was made on June 30, 1875. On that day three sensitive hairs were cut off, *i.e.*, all the hairs from one lobe, and the leaf was watched to see if any bad effect would result from the shock. As no mischief accrued, it was irritated on July 1, and it closed pretty well.

On July 3 the three sensitive hairs on the opposite lobe were also removed, and the leaf closed slowly. The spines on the outer half of the left lobe are nearly erect.

July 5.—The leaf is open to-day; but, though irritated all over the parts where the hairs had been, there was no response whatever.

July 6.—The leaf was again touched to-day as it had been yesterday; but, though carefully watched, there was not the least indication of any movement. After having noted this satisfactory result, I began in about twenty or thirty minutes afterwards to replace the pots on the shelves, when, to my utter amazement, I discovered that the leaf was then closed, but rather awkwardly, as the spines on the right side, instead of crossing those on the left, were turned inwards. On careful examination we could find no remains of any of the hairs which had been cut.

July 7.—Leaf quite open to-day. It closed slowly, but not perfectly,—the spines cross at an angle of about 45°.

The results of these experiments were somewhat puzzling. Why should the leaf close at all after the sensitive hairs have been completely removed? Can it be that, as we find in other instances in nature, a compensating power has been conferred on the tissues in the vicinity, so that when irritated they do call into action the contractile tendency of the lobes, though not with the same rapidity or certainty as the sensitive hairs did?

One thing, however, is apparent from these experiments, which is, that the sensitive hairs are the organs by the stimulation of which the instantaneous and perfect closure is effected, and that they seem to exert a peculiar co-ordinating influence over all the parts of the leaf; for when that influence is withdrawn, we find that the process of closing is effected in an awkward and disorderly manner.

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One Lobe cut away.

On July 2 I tried another experiment with somewhat interesting results. I cut longitudinally through the centre of a midrib, and thus removed one entire lobe. The remaining lobe immediately began to turn round, first at the petiolar end, and then at the distal end of the lobe. A dead fly was inserted into the partially closed distal end.

July 3.—The lobe has turned more round, and that portion of it near the petiole has brought the edge on a line with the midrib, and the spines project over it. The distal part has not turned so far round, but by pressure has pushed the fly somewhat out. The fly was pushed farther in to-day.

By the 7th it had projected beyond the midrib. The fly was firmly held; acid juice was poured out abundantly around it, and digestion proceeded.

In experiments on uninjured leaves I had sometimes observed that one lobe pressed with apparently more force than the other, and hence was seen with its margin considerably lower than the edge of its opponent, while at the same time the lobe bulged outwards, which was a necessary result of its edge being pressed lower down. The experiment which I have just detailed shows clearly that, in the ordinary cases of closing, the trap of the Dionæa is formed by the lobes acting with equal and opposing forces, and that it is to this peculiarity that we owe the difference between the Dionæa and the *Drosera rotundifolia*, *D. anglica*, &c.; for though belonging to the same natural order, and subsisting on the same diet, these Droseras and some other species (*e.g. D. Whitakerii*, &c.), curl round their victim, and the above experiment shows that when one of the lobes of Dionæa is removed, the *generic* tendency at once manifests itself.

Marginal Spines cut away.

On June 29, 1875, I cut off the spines or cilia from the margin of both lobes, and under these circumstances it was evident what an important part they play in the completion

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of the trap, as without them I believe that scarcely a fly of any vigour or energy could be caught; for even a weak and disabled one nearly escaped.

July 1.—Leaf open. An injured fly, which was consequently slow in its movements, was placed on it; and even it was only partially caught and retained, which it would not in all likelihood have been if the bases of the spines had not been left, which firmly clasped the fly by the middle.

III.—*Remarks on Solutions of the Hydrate of Chloral as Preservative Fluids for Vegetable Tissues.* By William Craig, M.D., F.R.S.E.

About eighteen months ago Dr Keen, Lecturer on Anatomy in the Philadelphia School of Medicine, published a pamphlet, in which he recommended a solution of the hydrate of chloral as an excellent preservative fluid for anatomical specimens. After reading his pamphlet, I put a wen, which I cut out of the head of a patient on the 18th of August last, in an ounce of water, to which I added five grains of the hydrate of chloral; and I now show this wen in a state of perfect preservation. I also exhibit a tapeworm from a hare, which was put into a solution of the same strength in December last; and it too is well preserved.

Being anxious to ascertain if vegetable tissues could be preserved in a solution of the hydrate of chloral, I made several preliminary experiments.

The first experiments were performed with solutions of the strength of 1½ grains of the hydrate of chloral to the ounce of water.

1. Leaves and fruit of *Solanum capsicastrum* were put into the solution in a common tumbler, and a piece of paper placed loosely over it to keep out the dust, but admitting free access of air. On the surface a fungus formed, but the specimen is in a good state of preservation, and even the colour of the ripe fruit is preserved. This specimen was put up on the 21st of November last.

2. On the 2d of December I put into a glass jar petals

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of a white Camellia, the flower of a Fuchsia, and the leaves and fruit of *Ardisia crenulata*. The vessel was covered with a piece of paper, but was not filled with the fluid. The leaves and fruit of *Ardisia crenulata* are well preserved, so is the flower of the Fuchsia, except that its colour is destroyed. The solution has penetrated into the cells of the petals of the white Camellia, rendering them transparent, but the tissue is otherwise preserved. They are slightly tinged with the colouring matter of the Ardisia fruit.

The following experiments were performed with solutions containing 1 grain of the hydrate of chloral to the ounce of water:—

1. Petals of a white Camellia. These remained for some weeks without apparent change, and afterwards the fluid gradually penetrated into the cells, rendering the petals transparent. They are, however, well preserved.

2. Leaves and flower of *Desfontainea spinosa*. This specimen is still beautiful. The leaves are green, and the flower yellow, having changed from orange; and the tissue is well preserved.

3. A yellow Chrysanthemum in full flower. This specimen is in an excellent state of preservation.

4. Fruit and flower of Fuchsia, flower of Chinese Primrose, and the frond of a Fern. In all of these the tissues are well preserved; the colour, however, has disappeared from the flowers of the Fuchsia and Chinese Primrose.

With the exception of the *Solanum capsicastrum*, the specimens were all put up on the 2d of December last, more than *six months* ago.

These experiments, although performed in a very crude manner, are sufficient to show that the subject is worthy of further investigation, and I hope on some other occasion to be able to bring before the Society the results of future experiments. Meanwhile we may safely infer from these experiments that many flowers and leaves may easily be preserved in a weak solution of the hydrate of chloral for some weeks, or even months, without losing either their form or their colour, and consequently could be sent even from a distant country in such a state that they could easily be figured by an artist or examined and described by a botanist.

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I am not without hope that a solution of the hydrate of chloral may even be found useful for preserving microscopic specimens. The solution is perfectly colourless, very cheap, and very fluid.

IV. *Notes of an Excursion to Connemara in September 1874.* By Professor Balfour.

On Friday, August 28, we left Belfast, where we had been staying in order to attend the meeting of the British Association, and going across Ireland by Mullingar and Athlone we reached Galway at 7.30 P.M. We had rooms in Black's Hotel, which is in the principal square of the town, and on the morning of Saturday 29th. we had an excellent view of the weekly market from our windows. We were amused at the dresses of the people, and at their gesticulations while buying and selling. The women were in general attired in coarse home-spun crimson petticoats, and large blue cloth cloaks with capes and hoods in which they envelop their heads. The men wore thick woollen stockings, corduroy knee-breeches, coloured or embroidered waistcoats, and black or green swallow-tail coats, the whole surmounted by a tall hat, so tall and narrow as to merit in a great degree the American title of "stove-pipe." During the forenoon, accompanied by Professor Cleland and Professor Dickson of Glasgow, we inspected the town of Galway, the streets of which are narrow and dirty, but contain some very curious old houses. The river Corrib flows through the town. On crossing one of the bridges some objects in the bottom of the river were pointed out to us. We took them to be weeds, and were speculating on their nature, when, to our astonishment, we were told they were salmon lying in groups waiting for the opening of the leap.

On the road to Queen's College we passed an old wall, on which we got plenty of *Ceterach officinarum* and *Asplenium Ruta-muraria*. Both of these ferns, as well as *Asplenium Trichomanes*, are very abundant in the district.

After visiting the College and grounds, Professors Cleland, Dickson, and I walked round by the sea-coast and picked up some good plants, the principal being *Gentiana verna*

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(in fruit), *Senebiera didyma*, *Utricularia minor*, *Schœnus nigricans*, *Chlora perfoliata*, *Statice Bahusiensis*, *Erythræa littoralis*, *Cladium Mariscus*, *Lycopus europœus*, *Calamintha officinalis*, *Scirpus fluitans*, *Œnanthe Lachenalii*, *Carlina vulgaris*, *Lythrum Salicaria*, *Dryas octopetala*. *Anacharis Alsinastrum* is very abundant in the Corrib.

We had been told that in the burial ground of the old parish church there was an olive tree about 200 years old. With some difficulty I found my way to the church, which is a partial ruin. I could not get inside the yard, but I saw a very large willow tree which some one had probably mistaken for an olive.

On Monday, August 31, we left Galway at 9.30 A.M., having on Saturday arranged for seats in the public car for Ballynahinch. We had written to Mr John Kelly at Roundstone to have rooms ready for us, and to send a car to meet us at Ballynahinch Bridge, there being no public car from that place to Roundstone. The car in which we travelled was seated for twelve, and was quite crowded, one man being perched up among the luggage in the centre.

We drove first along the shore of Lough Corrib. The country around Galway is very uninteresting; there is little vegetation and little or no cultivation, the principal feature in the landscape being the number of stones. In some parts every inch of soil appeared to be covered. One might fancy that a whole town had been knocked down and the stones left where they fell. In a few spots where was an attempt at cultivation the stones were left in heaps round the field. All the dykes were made of these stones loosely piled together. *Lythrum Salicaria* was extremely abundant, and the plants very fine. It and *Osmunda regalis* looked well, growing amongst the stones. We passed some very old family mansions, and in the distance the ancient castle of the O'Flahertys was pointed out to us.

On the roadside walls we saw abundance of *Ceterach officinarum*, *Asplenium Ruta-muraria*, *Scolopendrium vulgare*, *Asplenium Trichomanes*, and *Polypodium vulgare*, the latter particularly fine.

We changed horses first at Moycullen, an uninteresting little village, and then gradually left the shores of the

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Lough, and got into a prettier country than that near Galway. Our second stoppage was about two o'clock, at Oughterard, a straggling little place, with a large church, and a nunnery.

Passing Lough Bofin and Lough Arderry, we reached Half-way House, our next stoppage. It is situated near the end of Mamturk mountains, in the midst of a very desolate country. We had also a fine view of the mountains called the Twelve Pins of Bannabeola. Some of the mountains look very high, as they rise directly from the sea-level; but I believe none of the Connemara mountains attain a height of more than 2396 feet. *Dabeocia polifolia* now became extremely plentiful, and it was in fine blossom.

Having passed Glendalough and a deserted inn called "The Recess," we reached Ballynahinch about six o'clock. A lady who had been travelling with us all day, and who was going to be a teacher in the monastery school at Roundstone, alighted here also, and as she had a car in waiting, she kindly offered to take our baggage to Roundstone. Before starting in our car from this place, we examined a small lake close at hand, where we found *Utricularia intermedia*, *Drosera anglica*, *Drosera longifolia*, *Eriocaulon septangulare*, and *Rhynchospora fusca*. We also got some very fine specimens of *Ceterach officinarum* and *Asplenium Ruta-muraria* on Ballynahinch Bridge. We then started for our seven-mile drive to Roundstone, which we reached about eight o'clock. We got a warm reception from Mr Kelly, who told us that the Rev. A. M. Norman was staying in the hotel, and that Mr A. G. More from Dublin had taken lodgings in the village. The hotel was a nice old-fashioned place and very clean. We found that Mr More had just gone off seal-fishing. We took a short walk with Mr Norman through Roundstone. It is a little irregularly built place with its one street, standing on a corner of land, looking on one side over Bertraghboy Bay, and on the other side over the sea to the Arran Isles. The country was generally bleak, but this place looked lovely, for the dwarf whin (*Ulex nanus*) was in full bloom, and made a striking contrast to the various shades of purple of the heather.

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Next day we resolved to go and look for *Erica ciliaris*, which I found between Roundstone and Clifden in 1852, and which had since been sought for by others, but without success. At Craigga More we got plenty of *Erica Mackaiana*. I remembered that I had gathered *Erica ciliaris* near a bridge, and we therefore inspected the ground near two bridges, but the plant was not to be seen. Mr More discovered that he and Professor Babington, in their search for the heath, had looked at the wrong places. When we came to a third bridge, I at once recognised it as that which I had formerly visited. Since my return home I have looked at the notes of my excursion in 1852, and find the following entry:—"Near Craigga More, in marshy ground, on the left-hand side of the road and in hollow ground, we gathered *Erica ciliaris*, at the bridge which is the third on going from Roundstone." We were sorry to find that the marshy ground was gone, the river was properly banked, and all the heath had disappeared. We had no time to make a full examination of the banks of the stream above the bridge. I think that probably the heath may be still found in the district if a more careful search is made.

Rain came on, so we set off on our return to Roundstone, much disappointed at our want of success. We got good plants of *Rhynchospora fusca*, *Glyceria plicata*, *Eriocaulon septangulare*, several Droseras, besides *Erica Mackaiana*, *Dabeocia polifolia* (Mr Norman got one plant with white flowers), and *Erica cinerea*. The last named plant flowers so luxuriantly in Connemara, that it looks like a different plant from that which we find elsewhere.

On our return to Roundstone we went to a small lough close to the sea, in which *Naias flexilis* is to be found. It is called Lough Creg Duff. The water was so high that Naias was quite invisible. Naias is a connecting link between the flora of Connemara and that of North America. Mr Norman was fortunately well acquainted with its haunts, so he crept out on to a jutting rock, and, after poking about with a stick for some time, specimens of Naias floated to the top, and we succeeded in fishing it in with our umbrellas. Near the lough we found a very fine plant of *Asplenium Adiantum-nigrum* var. *acutum*, also *Radiola millegrana*.

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On Wednesday, September 2, Mr Norman and Mr More left early in the morning for Dublin. After breakfast we started for Urrisbeg, a hill behind Roundstone. We kept to the east side of the summit, and, crossing by a gap, began to descend towards the north. A few yards down Tommy (our guide) pointed out *Erica mediterranea*. We got some very fine plants, but none in flower. Urrisbeg is such a boggy hill, that walking was extremely disagreeable. After about half-an-hour's descent, we reached Lough Bulard, on the east side of which is a limestone rock, on which *Adiantum Capillus-Veneris* is to be found. We gathered some fronds and one or two plants. There was a great deal growing on the rock, but fortunately for the habitat it is impossible to get at the roots. We then re-ascended the hill, this time going to the summit, from which the view is very remarkable. The whole plain was so intersected with loughs and pools, that it was difficult to imagine how a road could ever have been made through it. In the distance on the west we saw Slyne lighthouse, to the south the Atlantic and the Arran Isles, to the east the Mamturk range, and on the north we looked to Clifden and the splendid range of Pins. Near the top of Urrisbeg we found one plant of *Saxifraga umbrosa*, and on the top *Sedum anglicum*.

We got back to Roundstone about two o'clock, and then started in a car for Clifden, whence we proposed to go to Letterfrack for the night. About two miles from Clifden we passed the bridge at which we had looked for *E. ciliaris*, and alighted to have another search. We met a gentleman, Mr Anthony Morris, who told us that this property (Ballynaboy) belonged to him and to an English friend, and that he remembered that at one time there was marshy ground and heath close to the bridge; that in improving his property he had banked the river, and so of course the heaths were destroyed, but they were so pretty that he had transferred some plants to his garden. We accordingly went to see them, in hopes that we might find a plant of the heath we wanted, but we were disappointed.

We reached Letterfrack, late in the evening, after being drenched with rain, which had descended in torrents for an hour. On the morning of the 3d of September Professor

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Dickson and I ascended a steep hill near Letterfrack, called the Diamond Pin, but got no plants worthy of notice, except *Saxifraga umbrosa*. Another of our party got a quantity of it growing close to the sea. We heard that *Asplenium marinum* was abundant also, but we did not get any of it.

We left Letterfrack about two o'clock, and drove through Kylemore Pass towards Leenane, which we reached about 5 P.M.

On Friday, 4th September, we started early for a 25-mile drive to Cong. We were now in the celebrated Joyce country, and had a charming drive through the Maam Valley, the view of the precipitous sides of the Mamturk range being very grand. On this side these mountains were much more imposing than they were on that which we had previously visited.

We passed Maam Hotel, and in a short time reached the shores of Lough Corrib. We were fortunate enough to find *Utricularia intermedia* in a pool on the roadside; it was in very fine condition. We also got a beautiful species of *Batrachospermum*. Near Cong, the appearance of the country improved; there was a good deal of cultivation, and the cottages looked clean and well-built. We heard that this was due to the interest taken in his property by Sir Arthur Guinness, who lives a great deal in his house at Cong.

When we arrived at the hotel, we got a small boy to act as guide, and went first to see the relative positions of Lough Mask and Lough Corrib, as there is supposed to be an underground river between the two. The country is composed entirely of limestone, and the caves formed in it by the underground water are very curious. The mouth of one, called the "Pigeon's-nest," was extremely like the entrance to a coal-pit. On descending by a rough flight of steps, we found ourselves at the entrance of a large dark cave, and we heard the sound of rushing water. Our guide lighted a wisp of hay and went far into the cave to show it, but we could not see very well until we lighted a piece of magnesium wire, which a gentleman at Letterfrack had given to us for the purpose. We walked through Sir Arthur Guinness's domain, which is beautifully kept. The

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river flows through it, and we saw in it several Potamogetons, which we took to be *P. longifolius*, *P. sparganifolius*, and probably *P. filiformis*. We visited the ruins of Cong Abbey, which have been put in very good order. In the abbey we found a plant of *Solanum Dulcamara*.

On Saturday, Sept. 5, we left Cong by steamer and sailed down Lough Corrib to Galway. The channel through which we had to pass was very narrow, marked off by rocks and buoys. The navigation was therefore somewhat difficult. Near Galway we passed through the Friar's Cut, a channel cut through a promontory from the Lough into the River Corrib. We reached Galway about mid-day, and left for Dublin in the afternoon.

8th July 1875.—Sir Robert Christison, Bart., President, in the Chair.

The following Communications were read: —

I.—*Notes on the Structure of the Leaves of Lathræa squamaria.* By F. M. Caird.

The leaves of Lathræa occur as white, fleshy imbricated, scales covering a branched underground stem. The smallest are horseshoe-shaped, the largest somewhat flattened and expanded, and there are others of intermediate size and shape. Externally they are glabrous, and slightly concave above; beneath, the thick convex outer border leads to a slit which passes inwards, and beyond that is the stem.

If we make sections of the scale, we find that the lighter-coloured portions correspond to cavities within its general substance; there may be upwards of twenty of these in the larger scales. By making longitudinal sections, we find that the cavities communicate with a canal which runs along within the recurved thickened margin of the leaf into which the slit opens. They may be traced from below, upwards and

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backwards, and their sinuous walls are lined by a prolongation of the general epidermic covering, which consists of polygonal nucleated cells. But while the external epidermis is glabrous and destitute of appendages, the internal is furnished with rudimentary hairs and stomata. The hairs generally consist of two, sometimes of three or four terminal nucleated cells, supported on a single basilar one; and frequently at the entrance to the cavities we find they have a long stalk composed of a column of cells, and this form is evidently a transition stage between the fully developed hairs as seen on the calyx, and the smaller rudimentary ones.

The stomata found in the stomatic cavities—if we may so term them—are dome-like and elliptical. They are made up of two guard-cells, with apparently two smaller ones outside, set upon a lacuna which seems to bear some relation to the surrounding fibro-vascular bundles.

The stomatic cavities may be due to an invagination of the epidermis, or a folding of the leaf on itself; and in this manner protection is afforded to the enclosed delicate epidermal organs.

Fibro-vascular bundles pass into the leaves, fork, and run around each of the cavities. The large cells forming the general mass of the leaf contain elongated angular starch grains and large nuclei.

Further Note.

Since writing the above, I find that Mr Bowman described the leaf cavities of Lathræa in the Trans. Linn. Soc., vol. xvi. He calls the rudimentary hairs "absorbents," and evidently conceived that they carried on the functions of stomata, of which organ he makes no mention.

II.—*Statistics Regarding the Size of certain Australian Trees.* By R. Etheridge, jun., F.G.S.

The following measurements relate to some of the commoner species of *Eucalyptus*. Baron von Mueller states that a fallen "peppermint" tree (*E. amygdalina*, Labilladière) in the Dandenong Forest, near Melbourne, was

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measured at his request by Mr D. Boyle, and found to be 420 feet in length; whilst another example in the same forest, measured by Mr E. B. Heyne, gave the following proportions:—

Length of stem from base to first branch, .	295 feet.
Diameter at this point, ...	4 „
Stem from first branch to a point at which it was broken off, ...	70 „
Diameter where broken, ...	3 „
Total length to fracture, ...	365 „
Girth, at 3 feet from the ground, . .	41 „

A second example measured 53 feet in circumference, at three feet from the ground. In the Black Ranges near Berwick, another tree of the same species was found by Mr G. W. Robinson to be 81 feet in circumference at four feet from the ground, and the same observer believes that *E. amygdalina* attains, near the sources of the Yarra-Yarra and Latrobe Rivers, in Eastern Victoria, the almost incredible height of 500 feet. A *Eucalyptus* (species not stated), was measured by Mr G. Klein on the Black Spur, near Healesville, and found actually to attain the enormous height of 480 feet.

The secretary of the Victoria Mining Department, Mr R. B. Smyth, F.G.S., states that it was ascertained by actual measurement that an acre of ground in the Dandenong State Forest supported twenty large trees of an average height of 350 feet, with 38 "saplings" of an average height of 50 feet, in addition to a vigorous undergrowth of large tree-ferns and other plants. An example of the same Eucalyptus as previously mentioned (*E. amygdalina*, Lab.), cut down on the Coranworabul Creek, Dandenong Forest, measured 330 feet in length, and at one foot from the ground 69 feet in circumference.

In the Mount Macedon Forest, a similar computation to the foregoing indicated, that on an acre of ground there were 42 large trees of another variety of *Encalyptus*, known as the "Messmate" tree, and 12 "saplings." Many of these trees were 6 or 7 feet in diameter at 4 feet from the ground, and from 200 to 220 feet high.

On the summit and slope of Mount Disappointment, in the Great Dividing Range, Mr Norman Taylor, of the

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Geological Survey, found the "Stringy-bark" (*Eucalyptus obliqua*, L'Heritier) growing to a height of 300 feet, with a diameter of 15 feet towards the base.

During a recent survey of the coal bearing rocks of the Cape Otway District, Mr Krause, Mining-Surveyor, took the following measurements of a "Messmate" Eucalyptus:—

At the base, . . .	53 feet	in circumference.
At 12 feet from the ground,	32 „	do.
At 20 „ do. do.	17 „	do.
At 110 „ do. do.	11 „ 6 in.	do.

Mr Krause also found that on the same line of coast an acre of ground carried 90 trees of the Ironbark (*Eucalyptus leucoxylon*, F. Mueller), the trees varying from 6 inches to 2 feet in diameter near the base.

One of the "White-gums" (*Eucalyptus Stuartiana*, F. Mueller), is nearly equal in height to the largest examples of the "Stringy-bark" (*Eucalyptus obliqua*), which average from 300 to 400 feet high; whilst the "Blue-gum" (*Eucalyptus globulus*, Labillardière), when growing in gullies and moist localities, attains a similar gigantic size.

In Western Australia, Baron von Mueller tells us that in a glen of the Warren River, the "Karri-Eucalypt" (*Eucalyptus colossea*, F. Mueller) is about 400 feet high, and that into its hollow trunk three horsemen, with an additional pack-horse, could enter and turn without dismounting.

III.—*Trees Struck by Lightning.* By James M'Nab.

For many years past, it has been customary to notice, at the Botanical Society's meetings, trees injured by lightning. A thunderstorm of rather a local character took place on the 9th of October 1874, on the road leading from Loanhead to Lasswade. The electric fluid struck a large healthy ash tree, which is now quite dead. It was one of a row of trees overhanging a line of telegraph posts and wires on the south-east side of the road. Five consecutive telegraph posts, standing 150 feet apart, were thrown down, and more or less split up. I recently inspected all the trees in the

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line where the posts were injured, and found that, without exception, they were either elm or ash. One ash, I have said, has been totally killed. It stood near the centre of the line where the telegraph posts were destroyed. The wires, however, do not seem to have been in contact with it, or indeed any of the trees. Another ash is also disfigured on one side, the bark being stripped off about two inches in breadth, beginning about six feet below the level of the wires, and extending to the bottom of the tree. Several of the elms have had narrow portions of bark, from two to three feet in length, and about one inch broad, displaced from their stems; and this has always occurred on the side next the wires. One elm, where the wire was within twelve inches of the stem, has a strip of bark, two feet long and about one inch broad, taken off immediately below the level of the wire. This denuded space is straight for several feet, and it is observed to turn round and reach the ground on the east side of the tree. Notwithstanding that the wires appeared to be at a greater distance from the ash than from the elm trees, the ash trees suffered most. Probably the ash tree killed was first struck, and the fluid afterwards communicated with the telegraph wires.

Sir Robert Christison has supplied me with the following particulars regarding the lightning-struck ash near the Dean Road toll-bar:—

"The tree was struck in July of last year, and still continues untouched. It is eight feet six inches in girth at five feet from the ground, and appears sixty feet high. It was a fine thriving tree previously. It has put out this year a great quantity of foliage, but much less than that of an ash close to the toll-bar, the nearest on the line of which the damaged tree is the fourth.

"The only damage I apprehend arising from the lightning, at least visible as yet, is stripping off the bark. Various long rents, indeed, now appear in the stripped wood, but not the slightest fissure was to be seen two days after the injury was inflicted. Whether the rents now seen arise from inward electrical damage, undeveloped at

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first, I do not pretend to decide; but probably drying and shrivelling are sufficient to account for them.

"The bark has been stripped from beneath the first large branches, about eighteen feet from the ground, down at the west part, to very near the bottom of the trunk. I imagine that two-thirds of the whole eighteen feet of trunk has been stripped of the whole thickness of the bark, so that the outer surface of the wood is perfectly and smoothly bare. The *upper five feet of trunk is entirely stripped round the whole circumference*, though in a somewhat oblique direction. This is interesting in relation to the great amount of foliage shown this year."

IV. *Open-Air Vegetation at the Royal Botanic Garden, Edinburgh.* By James M'Nab, Curator.

January 1875.—The past winter has been remarkable for its severity, particularly during December, when the thermometer was observed on twenty-seven mornings at or below the freezing point. The lowest markings were on the mornings of the 15th, 23d, 25th, 28th, 29th, and 30th, indicating respectively 17°, 18°, 17°, 13°, 5°, and 15°; whilst the highest night temperatures were on the 1st, 4th, 5th, and 6th, indicating 33°, 33°, 40°, and 38°. During last month (January 1875) the thermometer was fourteen times at or below the freezing point. During the past month the lowest markings were on the mornings of the 1st, 8th, 23d, 25th, 26th, and 30th, indicating 13°, 26°, 28°, 29°, 25°, and 26°; while the highest morning markings were on the 10th, 11th, 14th, 16th, 19th, and 28th, indicating 38°, 39°, 39°, 42°, 42°, and 44°. The following plants have bloomed in the open air during the month:—

Jan. 15. Corylus Avellana.
18. Galanthus nivalis.
„ Tussilago fragrans.
20. Primula denticulata.
„ Erica herbacea alba vera.
21. Hepatica triloba.
Jan. 21. Leucojum vernum.
„ Veronica alpestris.
23. Crocus susianus.
„ Scilla præcox.
24. Crocus Imperati.
25. Hepatica angulosa.
30. Eranthis hyemalis.

On the 1st day of January this year the only open-air flowers were *Jasminum nudiflorum*, four species of Helle-

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borus, and *Gentiana acaulis;* while on January 1, 1874, 138 species and varieties were collected in bloom.

February.—February has been exceedingly cold, easterly and north-easterly winds having prevailed during a considerable part of it. Snow set in on the 23d, and continued to lie during the remainder of the month, and up to the 11th of March snow was still to be seen on the northern slopes of the neighbouring hills. On twenty-one mornings the thermometer was at and below the freezing point. The lowest markings were on the mornings of the 4th, 5th, 10th, 12th, 17th, and 24th, indicating 21°, 16°, 20°, 27°, 28°, and 28°; whilst the highest morning readings were on the 1st, 2d, 7th, 13th, 14th, and 16th, indicating 43°, 35°, 34°, 37°, 41°, and 35°. The following is a list of the open-air plants as they came into bloom during the month of February:—

Feb. 2. Cyclamen Coum.
„ Primula vulgaris rubra.
„ Iberis gibraltarica.
3. Galanthus plicatus.
4. Rhododendron atrovirens.
„ Daphne Mezereum.
5. Dondia Epipactis.
6. Bulbocodium vernum.
8. Erica herbacea.
Feb. 10. Arabis albida.
„ Crocus vernus and vars.
15. Aubrietia grandiflora.
„ Primula purpurea.
„ Tussilago alba.
16. Knappia agrostidea.
„ Saxifraga oppositifolia alba.
„ Arabis procurrens.
28. Mandragora vernalis.

March.—The early part of March was cold, with easterly and north-easterly winds, which, with the cold of the previous months, have been the means of greatly retarding vegetation. Only on ten mornings was the thermometer at or below the freezing point, giving altogether 45° of frost, being 8° more than was registered during the month of March last year. The six lowest registerings were on the mornings of the 4th, 5th, 6th, 10th, 11th, and 12th, indicating respectively 27°, 24°, 28°, 25°, 24°, and 25°; while the highest morning temperatures were on the 8th, 22d, 25th, 26th, 30th, and 31st, indicating respectively 45°, 42°, 46°, 45°, 42°, and 42°. The *Ribes sanguineum* showed its first flowers this year on the 30th of March, while last year it was recorded as flowering on the 3d—a particular plant

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being fixed on for annually recording its blooming. On the 31st of March, the elm, willow, alder, hazel, and poplar were in flower, and a few green leaves were to be seen on the lilacs, crab apples, *Mespilus canadensis*, and some of the thorns in sheltered situations.

List of Plants as they came into Bloom during the Month of March.

Mar. 4. Potentilla alba.
6. Sisyrinchium grandiflorum album.
„ Tussilago nivea.
„ Saxifraga Rocheliana.
„ Leucocoryne alliacea.
„ Doronicum caucasicum.
7. Scilla bifolia vera.
„ Corydalis angustifolia.
8. Draba aizoides.
„ Primula marginata.
„ Sisyrinchium grandiflorum.
„ Triteleia uniflora.
10. Scilla sibirica.
11. Nordmannia cordifolia
13. Narcissus pumilus.
„ Rhododendrum nobleanum.
14. Scilla bifolia major.
16. Saxifraga oppositifolia pyrenaica.
„ Saxifraga oppositifolia retusa.
„ Saxifraga juniperina.
17. Scilla bifolia alba.
„ Draba cuspidata.
18. Narcissus minimus.
„ Rhododendron præcox superba.
„ Saxifraga oppositifolia grandiflora.
19. Saxifraga oppositifolia bryoides.
Mar. 19. Iris reticulata.
20. Aponogeton distachyon (in pond).
„ Scilla bifolia rubra.
21. Erythronium grandiflorum.
„ Gagea lutea.
22. Corydalis tuberosa.
23. Scilla bifolia patula.
„ Puschkinia scilloides.
„ Omphalodes verna.
24. Merendera caucasica.
„ Orobus cyaneus.
26. Muscari botryoides.
„ Rhododendron caucasicum.
27. Muscari botryoides *var.* album.
„ Hyoscyamus Scopolia.
28. Muscari botryoides *var.* pallidum.
„ Orobus elegans.
29. Adonis vernalis.
„ Primula villosa.
„ Primula integrifolia.
30. Epigæa repens.
„ Primula nivalis.
„ Draba altaica.
„ Ribes sanguineum.
„ Symplocarpus fœtidus.
31. Symphytum caucasicum.
„ Hyoscyamus orientalis.
„ Erythronium Nuttalianum.

April.—The month of April has been remarkable for a long continuance of dry easterly winds, with a hot sun pre-

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vailing during the day. On seven mornings only was the thermometer below the freezing point, the lowest markings being on the 13th, 14th, 19th, 20th, 22d, and 24th of the month, when 28°, 31°, 29°, 30°, 25°, and 30° were respectively indicated. The highest morning temperatures were on the 1st, 2d, 25th, 27th, 28th, and 29th, when 43°, 43°, 43°, 44°, 43° and 48° were shown. On the 31st of April, about 250 species and varieties were counted in bloom in the rock-garden. The list appended does not include all these.

Plants in Bloom in April 1875.

1. Narcissus Pseudo-Narcissus.
   Primula minima.
2. Adoxa moschatellina.
   Helleborus colchicus.
   Soldanella montana.
3. Anemone apennina.
   Primula ciliata purpurata.
   Pulsatilla bracteata.
   Pulsatilla vernalis.
4. Anemone Robinsoniana.
   Dentaria macrophylla.
5. Narcissus bicolor.
   Helleborus angustifolius.
   Rhododendron anthopogon.
6. Androsace Laggerii.
   Muscari racemosum.
   Narcissus moschatus.
7. Aubrietia Hendersonii.
   Hutchinsia alpina.
   Saxifraga diapensioides.
   Gaultheria procumbens (*American variety*).
8. Arabis blepharophylla
   Cardamine bellidifolia.
   Petrocallis pyrenaica.
   Pachysandra procumbens.
   Schivereckia podolica.
   Andromeda tetragona.
   Erica sordida.
   Erica hibernica alba.
9. Anemone nemorosa flore pleno.
10. Primula Allionii.
10. Erica hibernica stricta.
11. Andromeda polifolia.
12. Aubrietia deltoidea.
13. Androsace coronopifolia.
    Coptis trifoliata.
    Lithospermum fruticosum.
14. Erythronium americanum.
    Trollius pallidus.
    Ornithogalum exscapum.
    Polygala Chamæbuxus.
15. Draba altaica.
    Sanguinaria canadensis.
    Menziesia cœrulea.
    Rhododendron ciliatum.
16. Anemone pulsatilla.
    Aubrietia conspicua.
    Dodecatheon integrifolium.
    Iberidella rotundifolia.
    Mysotis dissitiflora.
    Podophyllum Emodi.
    Saxifraga Maylii.
    Trillium grandiflorum.
    Rhododendron Chamæcistus.
17. Andromeda fastigiata.
    Erica hibernica minor.
18. Androsace carnea eximia.
    Asarum canadense.
    Aubrietia Campbellii.
    Comaropsis fragarioides.
    Claytonia virginica.
    Fritillaria imperialis.
    Saxifraga pennsylvanica.

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18. Erica hibernica stricta.
19. Adonis pyrenaica.
    Primula denticulata.
    Primula Dinyana.
    Mahonia glumacea.
20. Aretia Vitaliana.
    Draba Androsace.
    Erythronium giganteum.
    Gentiana verna.
    Globularia nudicaulis.
    Jeffersonia diphylla.
    Potentilla nivea.
    Saxifraga cæspitosa laxa.
    Bryanthus erectus.
    Erica hibernica intermedia.
21. Erythronium giganteum roseum.
    Iris verna.
    Primula pedemontana.
    Ranunculus amplexicaulis.
    Saxifraga Rhei.
    Sedum thymifolium.
22. Anemone nemerosa bracteata.
    Ranunculus gramineus.
    Scilla verna.
23. Draba rupestris.
    Primula ciliata.
    Primula cortusoides.
    Phlox setacea violacea.
    Salix retusa.
    Sieversia triflora.
23. Fritillaria Meleagris.
24. Ajuga pyramidalis.
    Saxifraga Wilcommiana.
    Rhododendron glaucum.
    Rhodora canadensis.
25. Alyssum montanum.
    Berberis Darwinii.
    Phlox aristata.
    Primula involucrata.
    Primula longiflora.
    Azalea procumbens (*American variety*).
    Menziesia empetriformis.
26. Anemone trifoliata.
    Bellis rotundifolia violacea.
    Draba gigas.
    Trichonema rosea.
27. Primula scotica.
    Pyxidanthera barbulata.
    Saxifraga aretioides.
28. Colurna laxiflora.
    Erysimum helveticum.
    Salix reticulata.
29. Helonias bullata.
    Primula japonica.
    Azalea procumbens (*Scotch variety.*)
    Menziesia Drummondii.
30. Convallaria majalis major.
    Primula cortusoides amœna.
    Saxifraga calyciflora.

May.—The month of May, upon the whole, was cool. The lowest thermometer readings were on the mornings of the 1st, 4th, 16th, 17th, 19th, and 22d, when 38°, 36°, 39°, 34°, 35°, and 39° were indicated; while the highest morning temperatures were on the 6th, 9th, 14th, 15th, 21st, and 28th, when 46°, 48°, 49°, 48°, 46°, and 46° were respectively indicated. For comparison with future years, I may state that the following trees were observed to be in bloom on the dates annexed to them:—

May 18. Horse Chestnut.
    Common Lilac.
  20. English Laburnum.
    Pavia flava.
    Hollies of sorts.
May 22. White Thorn.
  25. Persian Lilac.
  28. White Beam tree.
  29. Scotch Laburnum.
  30. Fraxinus Ornus.

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At the beginning of June, 300 species and varieties were observed in flower. Amongst these may be noticed the Helianthemums or Rock-roses, both single and double, in all shades of colour—yellow, white, pink, and red; Saxifrages, particularly the pyramidal flowering species, also dwarf Phloxes, Aubrietias, Rosa alpina pyrenaica, Veronica verbenacea V. alpestris and V. Guthriana, Erinus alpinus and E. hispanicus, Iberis corifolia, Primula luteola, Saponaria ocymoides major, Daphne Cneorum, Onosma echioides, Pentstemon procerum, Meconopsis aculeata, Lithospermum prostratum, Linaria alpina, Trifolium uniflorum, Anthyllis vulneraria, rubra, Fritillaria Kamtschatica, Papaver alpinum (with red, orange, and yellow varieties), Erigeron Roylei, Hippocrepis helvetica and comosa, Genista sagittalis and pilosa, Oxytropis cyaneus, Dianthus alpinus, Campanula thyrsoidea, Dryas octopetala, Rhododendron ferrugineum and hirsutum, Erica hibernica alba and hibernica stricta coccinea.

Plants in Bloom in May 1875.

1. Mahonia glumacea.
   Primula Palinuri.
   Salix herbacea.
   Saxifraga pedemontana.
   Trifolium uniflorum.
   Veronica pectinata.
2. Myosotis alpestris.
   Saxifraga nivalis (*American var.*)
   Thalictrum alpinum.
   Vella Pseudo-cytisus.
3. Carex Fraseri.
   Cornus canadensis.
   Phlox Nelsoni.
   Rubus arcticus.
   Saxifraga virginiensis.
   Tulipa pulchella.
   Wulfenia carinthiaca.
4. Anemone alpina.
   Menziesia globularis.
5. Cerastium alpinum tomentosum.
   Ledum buxifolium.
   Linaria alpina.
6. Arenaria balearica.
   Gunnera magellanica.
   Lychnis lapponica.
   Primula auriculata.
   Streptopus roseus.
   Uvularia sessilifolia.
   Veronica Guthriana.
7. Alyssum alpestre.
   Anemone Popeana.
   Potentilla tridentata.
   Salix serpyllifolia.
   Veronica glacialis.
8. Alyssum spinosum.
   Cornus suecica.
   Dryas octopetala (*Scotch var.*)
   Iris cristata.
   Saxifraga Maweana.
   Silene acaulis alba.
9. Androsace villosa.
   Antennaria dioica rosea.
   Erodium cinereum.
10. Erinus alpinus.
    Globularia trichosantha.
    Iberis corifolia.
    Iris iberica.

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10. Myosurus minimus.
Potentilla frigida.
Primula luteola.
Saponaria ocymoides major.
Silene acaulis exscapa.
Smilacina bifolia.
11. Saxifraga Bucklandii.
Saxifraga cuneifolia.
Erodium Reichardii.
Primula Parryii.
12. Azalea amœna.
Carex Vahlii.
Daphne Cneorum.
Ranunculus uniflorus.
Saxifraga nivalis (*Scotch*).
13. Chlorogalum Leichtlinii.
Erica australis.
Pentstemon Menziesii.
14. Erinus hispanicus.
Houstonia cœrulea.
Petrocoptis pyrenaica.
Ranunculus alpestris.
15. Ajuga orientalis.
Arenaria purpurascens.
Cortusa Mattioli.
Gentiana alpina.
Linnæa borealis (*American*).
Linum alpinum.
Onosma echioides.
Pentstemon procerum.
Potentilla Lupinoides.
Viola stricta.
16. Arenaria ciliata.
Astrantia minor.
Coronilla minima.
Dracocephalum grandiflorum.
Erinus alpinus albus.
Iberis Tenoreana.
Meconopsis aculeata.
Pernettya candida.
Phlox divaricata.
Saxifraga Clusii.
Trifolium alpinum.
17. Anthyllis montana.
Iberis jucunda.
Linaria origanifolia.
17. Lychnis alpina.
Rosa alpina pyrenaica.
18. Achillea Clavennæ.
Anthyllis erinacea.
Campanula pulla.
Fritillaria kamkschatica.
Linnæa borealis (*Scotch var.*).
Menziesia polifolia globosa alba.
Pæonia tenuifolia pleno.
Saxifraga Aizoon minor.
19. Delphinium nudicaule.
Oxytropis cyaneus.
20. Erigeron Royleii.
Gaultheria carnea.
Globularia cordifolia.
Pernettya candida.
Ramonda pyrenaica.
Viola palmata.
Viola stagnina.
21. Alchemilla pentaphylla.
Aquilegia cœrulea.
Patrinia nudicaulis.
Veronica saxatilis rubra.
22. Anthyllis vulneraria rubra.
Erigeron alpinum.
Eriogonum subumbellatum.
Linaria pilosa.
Saxifraga Guthriana variegata.
23. Astragalus Leontinus.
Genista hispanica.
Iris tenax.
Saxifraga nervosa.
24. Anemone palmata.
Dianthus alpinus.
Pernettya speciosa.
Silene maritima rosea.
25. Erodium macrodenum.
Saxifraga valdensis.
Saxifraga nepalensis.
26. Anthemis Aizoon.
Calceolaria Kellyana.
Camassia Brownii.
Campanula thyrsoidea.
Dianthus glacialis.

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26. Genista pilosa.
Mœhringa muscosa.
Oxytropis Hallerii.
Papaver alpinum aurantiacum.
Pentstemon humilis.
Ranunculus plantagineus.
27. Aquilegia alpina.
Bellium corsicanum.
Dianthus eximius.
28. Galax aphylla.
Potentilla ambigua.
Æthionema membranacea.
Dryas octopetala minima.
28. Phleum alpinum.
Rhododendron ferrugineum album.
Vaccinium Mortenia.
29. Astragalus alpinus.
Cheiranthus longifolius.
Dianthus neglectus.
Papaver alpinum album verum.
30. Alopecurus alpinus.
Helonias dioica.
Smilacina borealis.
31. Pernettya Pentlandii.
Tofieldia americana.

June.—The month of June has been somewhat dry and cool. The lowest thermometer markings were on the mornings of the 1st, 2d, 3d, 13th, 14th, and 21st, when 40°, 39°, 37°, 40°, 37°, and 39° were registered; while the highest morning temperatures were on the 12th, 24th, 25th, 28th, 29th, and 30th, when 53°, 49°, 54°, 48°, 49°, and 48° were respectively indicated. Easterly and north-easterly winds prevailed during the early part of the month. There were a few occasional showers, but no rain of any consequence fell till the 30th.

Owing to the dry weather, the herbaceous and alpine plants, particularly those in the rock-garden, have come very rapidly forward; but generally the flowering, with certain exceptions, was of short duration. On the 1st of July 273 species and varieties were counted in bloom, amongst the most conspicuous being Veronica rupestris and V. pinguifolia, Campanula turbinata and varieties, Acantholimon glumaceum, Scabiosa alpina, Saponaria ocymoides major, Onosma echioides, many crustaceous Saxifrages, Dianthus alpinus, D. glacialis, D. corsicus, Androsace lanuginosa, Genista sagittalis and G. tinctoria, Thymus Serpyllum album, Sedum ibericum, Papaver alpinum and its varieties, Silene alpestris, Lithospermum prostratum, Arenaria grandiflora, Delphinum Belladonna, Potentilla Dr André, Helianthemums (double and single), also the double Lotus corniculatus. One of the most striking plants on the rockery was a double Dianthus, known as the Fettes Mount Pink; this is a very free-flowering pale rose-coloured variety.

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Subjoined is a list of plants as they came into bloom during the last month, chiefly in the rock-garden.

Plants in Bloom in June 1875.

1. Arenaria grandiflora.
   Dianthus Henryanus.
   Fragaria lucida.
   Linum campanulatum.
   Primula sikkimensis.
   Silene alpestris.
   Thalictrum tuberosum.
   Veronica verbenacea.
2. Anemone alba.
   Crespedium Richii.
   Erodium absinthifolium.
   Linaria alpina atropurpurea.
   Pernettya augustifolia speciosa.
   Primula farinosa.
   Veronica pellonia.
   Vicia argentea.
3. Actinella scaposa.
   Aster alpinus albus.
   Campanula fragilis hirsuta.
   Dodecatheon Foxii.
   Scutellaria alpina.
4. Arenaria cæspitosa.
   Hydrocotyle sibthorpioides.
   Menziesia polifolia vera.
   Pentstemon acuminatum.
5. Aster alpinus.
   Dianthus cæsius.
   Epilobium latifolium.
   Hippocrepis helvetica.
   Onosma echioides.
6. Astragalus vaginalis.
   Cerastium grandiflorum.
   Hippocrepis comosa.
   Oxytropis lapponicus.
   Potentilla alpestris.
   Sedum stenophyllum.
   Silene maritima flore pleno.
7. Bupleurum ranunculoides.
   Campanula turbinata.
   Saponaria cæspitosa.
   Veronica pinguifolia.
8. Crucianella stylosa rubra.
   Gypsophila repens.
   Helianthemum piloselloides.
   Oxytropis deflexa.
   Scutellaria altaica.
   Sedum deficiens.
9. Chrysobactron Hookerii.
   Cimicifuga americana.
   Robertia taraxicoides.
   Silene ciliata.
10. Aquilegia chrysantha.
    Epilobium Novæ Zealandiæ.
    Menziesia polifolia versicolor.
    Potentilla sikkimensis.
    Stellaria scapigera.
    Thalictrum formosum.
11. Arum palestinum.
    Dianthus dentosus.
    Kalmia angustifolia.
    Androsace lanuginosa.
12. Artemisia sericea.
    Campanula picta.
    Carex frigida.
    Centaurea uniflora.
    Lindelofia spectabilis.
    Scabiosa alpina.
    Stellaria pungens.
13. Prunella pyrenaica.
    Sagina procumbens pleno.
    Sedum Aizoon.
    Silene petræa.
    Veronica taurica.
14. Arenaria Ledebourianum.
    Epilobium obcordatum.
    Globularia nudicaulis.
    Lotus corniculatus flore pleno.
    Pyrola media.
15. Acantholimon glumaceum.
    Bupleurum Sikkimense.
    Erica ciliaris.

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15. Hemophragma heterophylla.
    Trientalis europæa.
16. Sedum Kamtchaticum.
    Veronica Girdwoodiana.
17. Paronychia serpyllifolia.
    Potentilla lanuginosa.
    Sedum asiaticum.
18. Helianthemum Tuberaria.
    Œnothera marginata.
    Potentilla Dr André.
    Scabiosa graminifolia.
19. Gaultheria Shallon acutifolia.
    Gentiana Wallichii.
    Stenactis speciosa.
    Campanula cenisia.
    Santolina incana.
20. Æthionema cordifolia.
    Coronilla iberica glauca.
    Nigritella angustifolia.
    Paronychia tomentosa.
    Potentilla Louis Van Houtte.
21. Campanula linarifolia.
    Campanula turbinata elegans.
    Scutellaria hastata.
    Sempervivum Laggerii.
22. Erica Mackaiana.
    Lewisia rediviva.
    Sedum alsinifolium.
    Saxifraga rivularis.
    Wulfenia Amherstii.
23. Asperula cynanchica.
    Linum viscosum.
    Saxifraga aizoides.
    Thymus corsicus.
    Thymus Serpyllum hirsutum.
    Zygadenus elegans.
24. Calochortus luteus.
    Mediola geranioides.
    Thymus Serpyllum album.
25. Campanula Van Houttei.
    Orchis foliosa.
    Oxytropis campestris.
26. Dianthus deltoides.
    Potentilla dahurica.
    Potentilla sericea.
    Sedum californicum.
27. Prunella pyrenaica.
    Thymus alpinus.
28. Dianthus versicolor.
    Potentilla dahurica.
    Sedum ibericum.
29. Iris ficifolia.
    Teucrium Botrys.
    Thalictrum anemonoides fl. pleno.
    Vaccinium macrocarpum.
30. Draba glacialis.
    Gentiana gelida.
    Liparis Loeselii.
    Potentilla alchemilloides.
    Pterocephalus Parnassii.
    Sagina setigera.

July.—The weather during the month of July has been pleasant. Some days have been very warm, but for the most part the temperature has been moderate, easterly winds having prevailed. The six lowest thermometer readings were on the mornings of the 13th, 14th, 16th, 26th, 28th, and 29th, when 48°, 39°, 35°, 38°, 41°, and 40° were respectively shown. The six highest morning readings were on the 2d, 3d, 6th, 19th, 20th, and 21st, when 53°, 53°, 53°, 55°, 55°, and 56° were indicated.

On the 1st of August, 207 species and varieties were counted in bloom on the rock-garden, the most conspicuous

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of the herbaceous plants being Gentiana gelida, Thymus alpinus, Campanula turbinata (blue), and Dickson's white C. turbinata, Silene Schafta, Sedum ibericum, and S. kamtschaticum, Santolina Chamæcyparissus, Fragaria lucida, Disa grandiflora, Spiræa palmata, Cyananthus lobatus, Dianthus dentosus, Teucrium pyrenaicum, Linaria alpina, Lithospermum fruticosum, Crucianella stylosa rubra, Lilium auratum, Bellis rotundifolia cœrulea, Pterocephalus Parnassii, and many Ericaceous plants, particularly the Dabeocia polifolia, and its numerous varieties of purple, variegated, and white. The *Orobanche rubra*, parasitic on the roots of the White Thyme, is also conspicuous. The ten plants of *Yucca gloriosa* have blossomed; the spikes average 6 feet in height and 5 feet in circumference. Numerous plants of *Podophyllum Emodi* are now covered with fruit, each as large as a duck's egg, and of a rich crimson colour. Subjoined is a list of the better class of plants as they came into bloom into during the past month, chiefly in the rock garden:—

Plants in Bloom in July 1875.

1. Calliprora flava.
2. Hypericum Burserii.
   Teucrium pyrenaicum.
3. Anthemis Aizoon.
   Cyananthus lobatus.
   Dryas octopetala minima.
   Erica cinerea bicolor.
   Erica cinerea pallida.
   Machæranthera bicolor.
   Santolina Chamæcyparissus.
4. Acæna microphylla.
   Campanula Dicksoni.
   Campanula lanata.
   Gypsophila dubia.
   Sedum sempervivoides.
5. Campanula nitida.
   Dianthus ramosus.
   Echium rubrum.
   Saxifraga cochlearis vera.
   Sullivantia ohionis
6. Campanula carpatica bicolor.
   Campanula gracilis.
6. Lychnis japonica.
   Sedum retoridum.
   Spiræa palmata.
7. Campanula Hendersonii.
   Sisyrinchium cœlestinum.
   Vitadenia trilobata.
8. Oxalis bonariensis.
   Saxifraga Hirculus.
   Sedum multiceps.
9. Epipactis palustris.
   Lilium pulchellum.
10. Arum tenuifolium.
    Linaria hepaticæfolia.
    Polygonum vaccinifolium.
    Thymus Acinos.
11. Erica tetralix Lawsoniana.
    Petrocallis pyrenaica.
12. Micromeria Piperella.
    Teucrium aureum.
13. Salvia taraxacifolia.
14. Statice trinervis.
15. Arenaria laricifolia.
    Erica Watsonii.

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5. Scolymus grandiflorus.
   Statice globularis.
6. Gypsophylla arenaria.
   Illecebrum verticillatum.
7. Campanula Raineri.
   Convolvulus sabateus.
8. Teucrium corsicanum.
9. Erica ramulosa.
   Teucrium canum.
11. Bellium minutum.
    Erica cinerea atropurpurea.
    Veronica salicifolia.
22. Acæna pulchella.
23. Erica ciliaris.
    Gentiana asclepiadea alba.
23. Orobanche rubra (parasitic on the roots of Thymus Serphyllum album).
24. Campanula floribunda.
25. Campanula Hostii albiflora.
26. Micromeria Douglassii.
    Yucca angustifolia.
    Campanula isophylla alba.
27. Hypericum Coris.
28. Convolvulus sericeus.
    Cypella Herbertii.
    Sedum cyaneum.
29. Funkia cœrulea alba.
30. Symphyandra pendula.
31. Scabiosa Gramuntia.

V. *Notice of Palm House in the Royal Botanic Garden, Edinburgh.* By John Sadler (Plate IV.).

The Royal Botanic Garden of Edinburgh was founded in 1670, but for many years it contained no glasshouses for the cultivation of exotic plants. In 1788 it possessed only one greenhouse and two small stoves. In 1820, on its removal to its present site, the hothouse and greenhouse accommodation was greatly increased. In 1834 a large Palm stove was added, at a cost of upwards of £1500. This at the time was the largest house of the kind in Britain. It was in form an octagon, being 60 feet wide and 47 feet high. It was admirably suited for the growth of the Palms, but these in the course of a few years outgrew the dimensions of the house. In 1855 the Regius Keeper, Professor Balfour, after many strong representations, succeeded in getting a sum of £6000 voted by Parliament for the erection of a new building. In 1858 this new Palm stove was completed, at a cost of £6500. It is built to the west of the old stove, and contiguous to it, so that the two form one building The sides of the new house, as well as those of the old, are substantially built of sandstone, and the roof is formed of cast-iron curvilinear rafters. The form is that of a parallelogram. Its length from north to south is 96 feet 6 inches; its width from east to west is 57 feet, or, including the old house, 120 feet; and its height is 70 feet 6 inches.

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It has been found that a considerable amount of stone-work in such a building is preferable to iron, as a more equal temperature can be maintained, and more shade, which is so essential for the proper growth and development of many social species, is secured. The stone sides of the stove form an arcade 35 feet high all round, having the outside relieved by pilasters and entablature of the Tuscan style—the arches being filled in with glazed cast-iron frames. The glazed roof forms a handsome dome of two stages, each 17½ feet high. The lower one rises from the top of the sides to half the height of the roof, where a base is formed for the upper one. There are two galleries inside which project from the base of each of the two divisions of the dome. To the lower gallery the public are admitted, and from it a beautiful view is obtained of the tropical vegetation.

The stove is heated by hot water from four cast-iron saddle-boilers, on the Curator's (Mr M'Nab's) improved and patented principle. The iron pipes connected with these boilers are of 5-inch bore, and are 1316 feet in length. The Palms are grown in round wooden tubs—the larger ones resting on small iron rollers, and some of them measuring from 20 to 30 feet in circumference. Many of the Palms are large and healthy specimens. One magnificent tree of *Livingstonia chinensis* is 45 feet high. This genus was named by the late Robert Brown in compliment to Patrick Murray, Baron of Livingstone, who by a liberal supply of plants assisted in founding the Edinburgh Garden. The great leaves of *Arenga saccharifera* reach the height, in one plant, of 60 feet, and in another 50. The following are also large plants—*Sabal umbraculifera*, *Caryota urens*, *Euterpe montana*, *Seaforthia* (*Ptychosperma*) *Cunninghami*, *Corypha australis*, *Acrocomia aculeata*, *Phœnix sylvestris*, and *Elias guinensis*. A considerable number of species have flowered and fruited freely.

[The Society is indebted to the proprietors of the "Gardeners' Chronicle" for the Plate.]

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PROCEEDINGS AND TRANSACTIONS

OF THE

BOTANICAL SOCIETY.

SESSION XL.

11th November 1875.—Sir ROBERT CHRISTISON, Bart., President, in the Chair.

The President delivered the following address:—

The preparation of an annual address by the president of a scientific society imposes on his ingenuity a task which is sometimes of no little difficulty; so that one is apt occasionally to think that the custom, like some other apparently goodly time-honoured customs, might prove to be now more honoured in the breach than in the observance. The difficulty is all the greater when, as in my present predicament, the deliverer of the address has not the familiar acquaintance that most of his audience possess with the science which for a time he is called on to represent.

On confiding my embarrassment to my colleague, Professor Balfour, he made a suggestion which met both my deficiency in strict botanical resources and my scanty professional leisure at the present busy period of the year—viz., that I should offer you my gleanings in the several branches of natural science, gathered during my recent autumnal intervals of idleness, and while pursuing no definite line of inquiry, but accepting what came accidentally in the way as I roamed through an interesting country, observing little more than the surface of things.

It was my good fortune to spend repeatedly several days

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of August and September at the picturesque village of St Fillans, situated at the eastern end of Loch Earn. The district around is one of the most beautiful and interesting in all Scotland to one who has the requisite physical ability to make use of his opportunities; and, in point of attractiveness and convenient distance, I doubt whether there is any other to compare with it for him who, in holiday-time there, must nevertheless occasionally revisit his home professional haunts.

The district I mean is usually called Upper Strathearn. It extends for about twenty miles in the form of a rather narrow, and, on the whole, straight valley, in a direction nearly from west to east, between Lochearnhead and the town of Crieff; after which it opens out into a wide highly-cultivated lowland strath, familiar to the many who pass through it by rail from Stirling to Perth. Upper Strathearn was formerly a cross route, little frequented by the traveller, because not traversed by an unhallowed railway. But it has recently formed the coaching part of one of the Caledonian Railway Company's "circular tours;" and now a fine level road of twenty miles is travelled in the touring season by three large *char-a-bancs* each way, carrying in all about 120 passengers daily in one direction or the other. They pass through charming and ever-varying scenery. But he has seen scarce a tithe of the attractions of Upper Strathearn who does not linger in it, leisurely visiting its waters, its woods, its lateral glens, and its mountain-tops.

The strath commences in the west, where Strathyre from the south, and Glen Ogle from the north, meet at Lochearnhead village. Here its bounding mountains are about 2200 feet high. Their summits on one side are distant fully four miles from the summits on the other; but they usually present steep and lofty slopes of grass or heather near the lake. At the middle of the length of the lake, however—at Ardvoirlich—the mountain summits recede farther from one another. On the south bank, Glen Voirlich opens in the valley wall a wide gap, which is blocked up about three miles from the water's edge by Ben Voirlich, a fine mountain of 3224 feet, which overlooks all the surrounding reigon, and is familiar to us in Edinburgh as a fine dome,

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visible in clear weather at a distance of fifty miles; and opposite Glen Voirlich, on the north side of the lake, Glen Veich rises northward very gently for a long way up, and its terminal heights of 2200 feet are fully five miles from the lake edge. This structure of the country curiously affects the rain of the district. Often, during the frequent intermitting south-westerly rains, heavy showers are seen falling over Lochearnhead, and passing westward half way down the lake; but the rain-clouds are there caught by a side current of air from Glen Voirlich, and swept northward across the lake to Stron More, the eastern mountain boundary of Glen Veich, and thence transmitted to Loch Tay, without touching St Fillans, though in the original direction of the clouds.

The village of St Fillans consists of a large hotel at the outlet of the lake, a line of old cottages down the north bank of the river, and another line of new villas up the same bank of the lake.

At St Fillans the mountain-tops maintain the same elevation of about 2200 feet; they approach nearer one another by a full mile than at Lochearnhead; and their near slopes are much steeper, more rugged, and more broken by scattered cliffs and precipices. Immediately below the village the valley contracts almost to a gorge, with little more room at the bottom than suffices to form a narrow border on each side of the effluent river Earn. But a little lower down the vale opens up again into a wide cultivated flat, on the south edge of which stands the old house of Dundurn, now occupied as a farm-house. Another contraction succeeds, and after that a second wider and more level flat than the last, constituting the manorial grounds of Dunira House, which is situated on its northern edge. Another contraction follows, and then another still wider and much longer plain, in which the river Earn from Loch Earn, the Lednock from the northerly glen of the same name, and the Ruchill, which drains Glenartney in the south, all meet close to Comrie, famous for its earthquakes.

Eastward of Comrie the strath retains for the most part considerable width, is bounded no longer by rugged mountains, but by low, smooth heights, and is richly adorned

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with agricultural fields, and the finely wooded grounds of Lawers and Ochtertyre, extending to Crieff. These various, extensive, and generally level flats are obviously the bottoms of ancient lakes, drained by the river having gradually cut through the bulwarks formed by jutting spurs from the bounding mountains. The wild, rugged, steep, mountainous slopes fall abruptly into these lacustrine flats; and thus the contrast between the rough slopes of broken heath, grass, natural wood, and cliff, with the smooth, cultivated fields, manorial lawns, and planted forestry in the plains below, is everywhere very imposing, because unusual.

The geology of the district of Upper Strathearn has not yet been reached by the Government Geological Survey, and would require more time and more endurance than I now possess for its full investigation. But my gleanings may show more competent inquirers what a careful survey may elicit. The prevailing rock everywhere is mica-slate. In most quarters there is nothing else to be seen. On the north side of Lochearn, about a mile east from Lochearnhead village, there is a quarry of fine crystalline bluish-grey primitive limestone, such as occurs here and there in other quarters of the great mica-slate range of the Grampians. This quarry has been long worked for supplying the wants of an extensive neighbourhood. Near St Fillans, Macculloch, in his Geological Map of Scotland, marks a trap dyke as crossing the lake near its lower end. The fact is, that from the west end of the villas on the north margin of the lake, for half a mile of the road westward, a dark brown, fine-grained very hard trap, apparently basalt, is exposed here and there by cuttings for forming the road; several small natural exposures of the very same sort of rock may be also seen on the roadside opposite along the south bank; and on the face of the slopes overhanging the old village on the north several low cliffs of the same kind of rock are met with up and down to the height of 1000 perpendicular feet above the bottom of the valley, on the way to a small upland loch or "tarn," called Loch Boltachan. I have no doubt that this rock may be found extensively in the neighbourhood.

Wherever a horizontal or sloping surface of this hard rock is exposed in the lower parts of the hill-slopes it

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presents fine specimens of glacier grooving, scratching, and polishing. Immediately west of the last villas of St Fillans a quarry of the said rock is worked for house-building and road metal. A few yards beyond it, on the edge of an uphill path, there is shown a slab about 21 feet by 8, which is quite covered with characteristic grooves. The face of it rises towards NE. by E., at an angle of about 30°, and consequently it looks up the lake. The grooves, of various sizes, and perfectly parallel, rise obliquely across it, in a direction almost due west to east, which is almost exactly the dominant line of Loch Earn; and the stone otherwise is smoothly polished. I am sorry to add that it is undergoing a farther process of polishing as a slide for the village children, not by any means to its improvement as a geological specimen. On the opposite bank, within a mile of the outlet of the lake, there are at irregular distances three exposures of the same grooved rock on the roadside. Two of them are small. The third, a hundred yards east from Ardtrostan House, is a triangular slab, 18 feet long, and nearly 8 feet at its widest. Its face slopes upwards towards the south, and therefore looks across the lake, the angle of rise being about 25°. It is quite covered with shallow grooves and fine scratches, parallel to one another, ascending the face of the rock at a small angle, and in a direction from 9° S. of W. to 9° N. of E.—being the line of the Loch Earn valley at this part. The two small slabs nearer the lake outlet present scratches whose direction differs only by a very few degrees from that now given. Through the kindness of the Rev. Mr Drummond, I am able to put before the society a photograph taken by him of the Ardtrostan slab. As the prevailing rock on either side of the valley, especially in the lower regions of its lateral acclivities, is mica-slate, marks of glacier action are not to be looked for on so soft and destructible material. Consequently, I long looked in vain for grooved surfaces in the lateral valleys which join Strathearn in a cross direction. At last one instance was found in Glen-Gonan, which joins the main valley from the south nearly at right angles a short distance east of the old village. The glen rises very abruptly from the first lacustrine flat I have mentioned, that of Dundurn. About a

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mile from the bottom, and 600 feet above the flat, a very hard coarse sandstone crosses the crack up the glen. Over a space about 8 feet square this rock presents a polished surface, crossed by grooves and scratches in a direction nearly north and south, and exactly in the line of that part of the glen where the rock occurs. These groovings, therefore, are nearly at a right angle with all those I have hitherto seen in the main valley.

The evidence thus presented of glacier operations led me to look also for ice-borne boulders. Black's "County Map," which indicates a "Rocking-stone" up Glen Tarken, gave me great encouragement; and when I was told in the neighbourhood that it was a stone bigger than a big cottage, I became impatient for the search. It was easily found, two miles up a most desolate glen, in which, as beheld from the stone, there is not even a bush to be seen, except a solitary Scotch fir, more than a mile farther up, looking great from a distance, but dwindling on close approach to a very ancient-like dwarf, 25 feet high only, and 4 feet 2 inches in girth at 5 feet from the ground. But it grows in a wilderness, 1250 feet above the sea, at the bottom of the green, grassy corry-wall which closes the glen at its upper northern end. The "rocking-stone," unhappily, proved to be no true boulder, but a remarkable mica-slate rock, resting on a beautiful gently-inclined green sward—apparently a slip from a small cliff above at no great distance, shaped like a hay-stack, but with its four under sides much more inclined, and measuring 28 feet in length, 22 in breadth, and 24 in height. Besides for its magnitude, it is also remarkable, inasmuch as there is no other stone of even moderate size visible in the glen around. As for its rocking, the strongest clan in the Highlands could not stir it one inch.

The Strathearn mountains present few precipices of any great magnitude. In the upper part of Loch Earn there are only a few scattered small cliffs. Ben Vorlich has a precipitous appearance on its north face to the spectator passing along the road on the north bank of the lake. But the appearance is deceptive, and is produced by the steep concave acclivity for 1200 feet from the summit, being covered with loose mica-slate stones, which give the moun-

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tain a grand imposing appearance, as it closes and overhangs Glen Voirlich at its foot. There is scarcely even a low cliff on it to supply this vast stony accumulation. On its south face, however, there is a precipice of no great height, and occupying but a small proportion of the slope. Lower down the loch cliffs are more abundant; and at the foot of the loch, Dundurn Hill, or the Birren, opposite St Fillans, is a bold mountain of 2011 feet, everywhere steep, and on its east and north-east sides consisting chiefly of a succession of precipices, but with accessible ravines among them.

Loch Earn itself is 6½ miles in length, and at most places three-quarters of a mile in breadth. Unlike many other Highland lochs, it has very little swamp at its upper end, and none whatever at its outlet, close to the Hotel of St Fillans, where it becomes a rapid, narrow, strong river quite abruptly. It is supplied by so many mountain streams from Strathyre, Glen-Ogle, Glen-Ample, Glen-Voirlich, Glen-Veich, Glen-Tarken, and so great a multitude of ravine streamlets besides, that on one occasion of a three-days' rain, last year, the level of the lake rose two feet. But its banks, though they are in general such as to allow easy access to the water's edge, are high enough to prevent overflow, except at a few places in very heavy floods. The water, like that of other Highland lochs among the mica-slate mountains of the Highlands, is always very pure. When much reduced by long drought, Loch Earn seems to be almost exactly akin in all respects to Loch Katrine in point of composition. It contains mere traces of carbonate of lime, chloride of sodium, and colouring matter, with a little free carbonic acid. Although I have not made an exact analysis, I am confident that the whole solids cannot exceed a 40,000th part of the water. The first rains, after long drought, render the water slightly more coloured; but after the three days' rain already mentioned, the colour was less than it was even after long dry weather, probably because the first days of the storm would wash away the greater part of soluble matter produced in peat and turf by exposure to previous sun and air. In this last condition the action of reagents was so much reduced that the water

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presumptively held not more than a 50,000th at most—probably nearer a 60,000th only—of solid matter.

I could obtain no sound information as to the depth of Loch Earn. Presuming that it would be considerable, and being anxious to repeat upon this lake the observations I had previously made on the deep-water temperature of Loch Lomond, I took soundings at various parts, but found no deeper water than 43 fathoms, nearly opposite the farm of Derry. I was assured, indeed, that opposite Edinample Castle, at the upper end of the lake, eighty fathoms had been observed; but careful trials across at distances of fifteen oar-strokes, gave only twenty-seven fathoms, for the deepest water there. Forty-three fathoms was not deep enough water for a satisfactory observation. On 22d September of last year (1874), the air temperature being 59°·5 F., the surface was 54°·5, and the water at 43 fathoms 46°. I expected to have found it lower; for in Loch Lomond at 42 fathoms I obtained 42°·0 or 42°·5. The extraordinary continuous mildness of the previous winter of 1873–4 may have caused the difference, or perhaps the greatly inferior depth of Loch Earn.

Of course, the feeding streams must be of equal purity with the lake. There are many fine springs in the district, though none of them voluminous. I have examined six, which contained between a 16,000th and 21,000th of solids, the same in nature as the solids of the ordinary simple spring waters of the hilly country both in the Lowlands and Highlands. I have never yet found a true spring water which presented the slightest trace of colour when tested by the severest of all tests—a 16-inch glass tube held over a sheet of pure white paper. In long drought the streams supply the lake chiefly with spring water, which, however, contrives to pick up a trace of colour in its descent, or in passing through peaty hollows near its source. The rain water which floods these streams is of course also free from colour. It is also, and naturally in this midland district, extremely pure in other respects. Collected in a south-easterly rain, when the wind was by no means strong, and at a place where no house stood to windward, the water was not visibly affected by our most delicate chemical reagents. But it soon acquires a trace of salts and of colour,—

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but a mere trace, as it descends the mountain sides. The lake water thus is always slightly coloured.

The purity of the water of the streams adds greatly to the beauty of the numerous waterfalls in high floods, because the broken water is of silvery whiteness, not brown or yellow as in flooded lowland rivers. Spout Rolla, a fall of about 135 feet on the Lednoch, about five miles above Comrie, had, in point of volume, when in high flood after three days' rain, all the magnificence of the Falls of the Clyde, though pure white in hue. In similar circumstances a fall in Glenartney, about four miles up the Ruchill, which has in the middle of it a broad shelf, favourable to the ascent of salmon and sea-trout, enables one to see admirably, from a rock overlooking the shelf of broken white water, the frantic efforts of the numerous fish to ascend the upper leap; as their black noses and backs render every attempt most visible, owing to the complete contrast of colour.

Considering the slight peaty impregnation of the water of Loch Earn, it follows that the lake ought to support the life and growth of the green, slimy, confervoid, vegetable-looking matter, which is met with in peaty water, attached to immersed stones near the edge, and which in some lakes such as the now notorious St Mary's Loch, constitutes, in the dried-up, withered, bleached condition after long drought, what poets recognise as the "silver strand." At Loch Earn there are few stony beaches which are left dry in long droughts. But near Ardvoirlich there is a suitable one, and there, accordingly, we have the green slimy confervoid growths on the stones within the water's edge, and fringing it outside a silvery band of stones thickly covered with the same matter, dried and blanched by long exposure to sun and air, and occasionally sprinkling with spray or scanty rain. I have supplied Dr Balfour with specimens for the museum of—1. A stone with this matter dried on it in the fresh and green condition; 2. A specimen of the same extended and dried on a slide for microscopic examination; 3. A stone covered with the bleached matter, in a radiated fibrous sheet, from the silver strand near Ardvoirlich, and 4. A large sheet of the same from the top of a stone much too large for convenient removal. On examining No. 1,

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while in the water, the matter is distinctly seen to stream away from the stone in dark green branching tufts, which one would at once pronounce to be vegetable in nature. But on examining a portion microscopically, such as No. 2, it is clearly seen to consist of nothing else than a few delicate cylinders, round which are interlaced numberless diatoms, consisting chiefly of spicular *Synedra splendida*, with a good many ladder-like specimens of a *Tabellaria*, a few of *Achnanthes*, and rarely a *Gomphonema*. The withered specimens, 3 and 4, present the same composition.

Having these rather repulsive-looking, but really most curious and interesting, bodies at command in their living state, I was anxious to test by actual experiment the truth of a suggestion thrown out in my account of the waters of St Mary's Loch and its effluent stream the Yarrow, given to the Royal Society three years ago—that the diatomaceous growths live upon the peaty matter in the water, and consequently abstract from it organic colouring matter, and purify it. The length of time required for making a good experimental trial is so great that I could make only one; and it was not in all respects exactly comparative. But the result so far was that the fresh diatomaceous mass did not thrive in spring water, and was gradually broken off in small fragments from the stone to which it was attached; while in the loch water, supplied from time to time with a little colourless spring water as it lost volume by evaporation, and also in a much stronger peaty water, the growing material throve better, and did not break off nearly in such quantities, and the colour appeared less in five weeks. I cannot pledge myself, however, to the accuracy of this my first and only experiment.

A mica-slate country covered with grass and heather, or in their absence with stones, is not likely, even although mountainous, to prove a rich field to the botanist. Moreover, as I was not in the district till the middle of August, the season was rather late for the detection of the rare Highland species, if there be any such among the hills and glens of Strathearn. What particularly struck me in regard to vegetable life there is the favourable nature of the climate for the growth of trees and shrubs, owing probably to the frequency of rain, the protection its northern moun-

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tains afford against northerly winds, and the small elevation of its bottom above the sea—that being at Lochearnhead only 310 feet, though it is distant nearly sixty miles from the nearest part of the German Ocean, and thirty-five miles in a straight line from the entrance of the river Earn into the Firth of Tay.

The upper part of the banks of Loch Earn is rather bare of wood. But at Edinample Castle, the earliest stronghold of the Breadalbane family, at the upper end, there are some very fine thriving sycamores and limes, measuring from 12 to 14 feet in girth at 5 feet from the ground, already lofty trees, and promising to be still more so. At Ardvoirlich there is on either side of the wide glen a great extent of wild natural copse, of oak and birch chiefly, which only requires to live in order to become a forest; and eastward of the house of Ardvoirlich there is much planted wood, chiefly larches, which, close on the roadside, are from 90 to 100 feet tall by actual measurement, and vary from 8 to 10 feet in girth at 5 feet from the ground. One which had been quite recently cut down presented, where it was cut close to the ground, eighty-two annual rings, twenty-seven of which occupied the first 6 inches of the radius, and the remaining fifty-five 6 inches only. As the ten exterior rings occupied a radius of half an inch only, the tree had plainly ceased to grow, and probably on that account had been cut down. The wood, however, was sound to the core, even to the very bottom. Nearly a mile east from the mansion of Ardvoirlich, a natural mound rises from the roadside to the height of about 80 feet, and is topped by a solitary old Scotch fir, of very picturesque form. As it stands alone, it is a conspicuous object from a considerable distance on the lake or across it. It has the character at St Fillans and Lochearnhead of having been the "hanging-tree" of Ardvoirlich, on which the chief in former days suspended his own rogues as well as his enemies when caught offending; but the present family deny the tradition, and consider the tree not old enough. It is about 55 feet high, and measures 9 feet 6 in girth at 5 feet from the ground. It may be old enough, if it has for some time grown as slowly as between September 1874 and September 1875; for I could not make out the slightest

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difference. Among and near the tall larches some native oaks have attained a considerable size, and are thriving vigorously. Between this and St Fillans the natural wood which extends far up the slopes, is only now passing from the state of copse to that of forest. In the grounds of Dunira are again seen in great abundance stately trees, chiefly of larch, silver fir, and spruce, about the same size as those of Ardvoirlich. The same luxuriance of pine forest is met with on the west bank of the Lednoch, near Comrie. But the finest forest trees of other kinds are those on the property of Lawers, east of Comrie, and that of Ochtertyre, between Lawers and Crieff. On the former the highway passes through a long and splendid alley of beeches and oaks measuring 12 and sometimes 14 feet in girth. In the Ochtertyre grounds fine larches and spruce abound, also aged ash trees of great size, one of which, to appearance quite healthy, measures 20 feet in girth at 5 feet from the upper ground of a steep bank on which it grows. I apprehend there are very few growing ash trees in Scotland of the same magnitude. A native tree which grows in this district to a size I was not previously aware of is the alder. About two miles up Glen Veich there is a steep bank of short grass on the east side of the stream, which is dotted like a gentleman's lawn with old but mostly decaying alders. The trunk of several measures 10 feet in girth at the narrowest part before branching, and one measured so much as 12 feet. But the most remarkable thing about them is that about a third of those I inspected have formed a strange alliance with the mountain ash. One of these, of which I present a drawing, consists of a great alder-trunk, enclosing the trunk of a healthy mountain ash, about 3 feet in girth, so closely that the two form seemingly one trunk. (Plate VI.) Another mountain ash rises from the very middle of the trunk of an alder 12 feet in girth, and at the height of 5 feet bends abruptly outwards, as if it were a branch of the alder itself, 42 inches in girth. In all these embraces the two species are so closely pressed together that it is difficult to say whether there is union between them or not. But I came to the conclusion that there is none.

Native shrubs also grow luxuriantly in this district. I

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ALDER & MOUNTAIN-ASH. P. 406.

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have been much struck especially with the luxuriance of the dog-rose. It must have been a splendid sight when in flower in July, dotted as it is over the extensive green, grassy slopes 300 or 400 feet above the edge of the lake. It was not my good fortune to see the shrub in this state. But its stature, its trunk, its foliage, and, in September, its profusion of crimson fruit, were very striking. I have been able to supply Dr Balfour with a trunk which measures 8 inches in girth. It shows very distinctly twenty-one annual rings, but outwardly looks much more venerable than these indicate. In its fresh state, a transverse section at any point shows beautifully the transverse medullary rays passing through the wood from its centre more than half way into the bark. Young twigs of the dog-rose have a large pith surrounded by pliant feeble wood. But a trunk of eight or ten years is very dense, strong, and tough when dried; and as it is easy to get one 5, or even 6, feet long, I recommend it to Dr Balfour and the Alpine Botanical Club as a first-rate material for a Scottish Alpenstock. Another example of luxuriance among shrubs is the common juniper. Low down, it tends even to put on the character of the erect variety, and would probably succeed with a little kindly training. In general, however, it preserves the characteristic procumbent modesty of the Highland juniper. On the steep acclivity north of the village, on the way to Loch Boltachan, I found, at the height of 1250 feet, a solitary ancient bush, 6 feet high, and of great extent, rising in several stems, or probably branches, from a trunk concealed by a conglomeration of big stones which cannot be removed. One of these branches, twisted like the letter S, I brought away for Dr Balfour, as evidence that it has attained the girth of 14 inches. It presents fifty-four annual rings; and both its whole wood and the bush itself are perfectly healthy.

I should like, in conclusion, to say a word or two about Ben Voirlich. With little rock, and none on the side towards Loch Earn, it is nevertheless a very fine mountain, whether seen from a northerly and near point of view or from some distance east; as, for example, from several points of the Stirling and Perth Railway, whence it is seen with a very pointed top and steep declivities. Its ascent

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of 2900 feet from the loch's edge (3224 in all) is, for the most part, easy from Ardvoirlich House gate, first along a rude path, then over luxuriant grass and little heather, next over short grass, then up 300 feet of disagreeable scattered loose stones, and, lastly, over a curious thick, soft, dense carpet of intermingled moss, crowberry, grass, and bilberry. In spite of its altitude, the summit is not bare, like the mica-slate mountains of its own height generally throughout the Highlands. The summit is a narrow, slightly saddle-shaped crest, with two roundish heads, on the east one of which has been erected the Ordnance cairn ; and the only stones seen on the top are those of the cairn. The rest of the summit is a thin continuation of the carpet immediately below, all of its component plants being dwarfish, and especially the bilberry. Luxuriant close bilberry, let me add, clothes the whole summit of Dundurn Hill, 2000 feet above the sea ; and the top of a hill of the same height, on the opposite side of the strath, is entirely covered with luxuriant bearberry.

Ben Voirlich top commands a magnificent prospect, and I was fortunate in being favoured with a singularly clear atmosphere. I must not dilate upon this theme here. Let it suffice that we saw the Glen Tilt mountains in the east, those of Braemar in the north-east, Ben Lawers, of course, near us to the north, Ben Lomond and the Arrochar mountains westward, and in the north-west Ben Nevis with its great precipice, the sections of which we could analyse easily with the telescope, though forty miles distant—besides Ben More, Stobinean, Dr Balfour's recent favourite Ben Louy, and Ben Douran, and also Meal Girdy, Ben Heschkernish, and others in the same quarter, which at our distance appeared quite as tempting to the botanist as their two neighbours, which Dr Balfour has recently made famous by his discoveries and his misadventure.

I ascended Ben Voirlich a second time a week afterwards, partly to repeat the view from the summit, partly for one of a series of experiments on the alleged property of the Peruvian *Coca*, or leaves of the *Erythroxylon Coca*, to replace food, preserve vigour, and prevent fatigue during such severe bodily exercises. I must reserve details for another occasion. But I must say now that I have con-

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stantly experienced the invigorating effects observed on the natives of Peru by travellers in that country.

The following statement respecting the Members was read by the Chairman :—

Honorary Fellows:—

Royal Personages, ...	3
British Subjects, ...	6
Foreign, ...	25

Ordinary Fellows elected during 1874-75.

Rev. George Alison.	John G. M'Kendrick, M.D., F.R.S.E.
Aghornáth Chattopádhyáy.	W. J. Normand.
Rev. John Clark.	Charles Pearson, C.A.
James Cowper.	D. Thomson Playfair.
D. C. Davidson, L.R.C.P. and S.E.	C. S. Stephenson.
P. B. Gibb, M.A.	Rev. Wm. Turner.

Non-Resident.—John Gibson, B.A.
Associate.—Andrew Brotherston.

Deduct Deceased, ...	10
„ Resigned, ...	1
„ Cancelled, ...	1

The following are the Obituary notices for the year :—

James Williamson Edmond was a distinguished student of medicine at the University of Edinburgh. He devoted special attention to botany. In 1870 he received the degrees of Bachelor of Medicine and Master in Surgery, with honours of the second class. He became medical attendant in the Asylum at Inveresk, and was a young man of great promise. He gave much aid to Dr Carrington in the preparation of his work on "British Hepaticæ," more especially in the microscopical part of the investigations. He joined the Society in 1870, and died on 22d March 1875.

John Edward Gray was born at Walsall in 1800, and died in March 1875, having just completed his 75th year. He was a son of Mr F. Gray, author of the "Supple-

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ment to the Pharmacopœia," and grandson of Mr S. Gray who translated the "Philosophia Botanica" of Linnæus. It was intended that he should enter the medical profession, but his studies were early directed to botany and natural history. In 1819 he joined the London Philosophical Society, and in 1822 he became a fellow and the secretary to the Entomological Society of London, which afterwards became the Zoological Club of the Linnean Society; and ultimately in 1826, was developed into the Zoological Society. Dr Gray was one of its most active members until failing health laid him aside. In 1824 he was appointed an assistant in the Natural History Department in the British Museum, of which he was appointed keeper in 1840. Dr Gray's life was one of unceasing activity for more than half a century, and he published very numerous books, memoirs, and papers in all departments of natural history. In 1852 the honorary degree of Doctor of Philosophy was conferred upon him by the University of Munich, and in 1860 he received the large gold medal of merit from the King of Würtemberg. He was a member of many foreign societies and academies. He was elected a fellow of the Linnean Society in 1857, and of the Botanical Society of Edinburgh in 1837.

Frederick Hellwig was elected a foreign corresponding member of the Society in 1843, and contributed at that time to the Herbarium. He died at Sommerfeld, Berlin, on 17th March 1875.

Andrew Inglis was born in Edinburgh in 1837, and was educated, under the care of his father, Dr Archibald Inglis, at the High School and the Edinburgh Academy. He afterwards studied medicine at the University of Edinburgh, and obtained the degree of M.D. in 1859. In 1860, he was admitted a licentiate of the Royal College of Surgeons, and in 1863, a fellow of that body. He continued to pursue his studies in midwifery, and in 1867 lectured on that subject in the Edinburgh Extra Academical Medical School. In 1869, he was appointed to the Chair of Midwifery in Aberdeen, the duties of which he discharged till about two years ago, when his health broke down. He

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obtained two years' leave of absence, but his health did not improve, and after a long period of great weakness, he died under an attack of congestion of the lungs, on 13th March 1875, at the age of 38. He joined the Society as a Resident Fellow in 1856. He was a zealous student of botany, an active field botanist, and even after the very serious impairment of his health, lost no opportunity of collecting specimens of interest. Among other things collected during his illness may be noted the very remarkable monstrosity of *Primula vulgaris*, described by Professor Alexander Dickson, at the last meeting of the British Association at Bristol.

Sir WILLIAM JARDINE, Bart., of Applegarth, was born in Edinburgh, in February 1800, and died in the Isle of Wight on 21st November 1874. He was the son of the sixth baronet, by a daughter of Thomas Maule, the representative of the Earls of Panmure. He attended medical classes in Edinburgh with the view of entering the medical profession, but having succeeded his father when he was only 19 years old, he took up his residence at Jardine Hall, his family dwelling-place. He was very fond of botany and natural science, and formed a large collection of natural history objects. In 1825, he and Mr Selby of Twizell, commenced the publication of "Illustrations of Ornithology." In 1833, he began "The Naturalists' Library," which was completed in forty volumes within ten years. He also published a new edition of Wilson's "American Ornithology." He was for some years joint editor of the "Edinburgh Philosophical Journal" along with Professor Thomas Anderson and Professor Balfour. He also wrote the following:—New edition of "White's Selborne," "British Salmonidæ," "Ichnology of Annandale," "Contributions to Ornithology" in 3 volumes. He was a fellow of the Royal Societies of London and Edinburgh, and at one time president of the Berwickshire Naturalists' Club. He joined the Botanical Society in 1841.

WILLIAM MACDONALD was born in 1798, and died at St Andrews on 1st January 1875. He inherited a good estate in Argyllshire, and applied himself to executing extensive improvements on his property. Unfortunately he involved

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himself in financial difficulties, and was obliged to sell the estate. He then studied medicine, and received the degree of M.D. at Edinburgh in 1830. He was a fellow of the Royal College of Physicians, the Linnean Society, and the Royal Society of Edinburgh to which he contributed several Zoological papers. In 1849, he was appointed to the chair of Civil and Natural History in St Andrews, which he held up to the time of his death. He made a large collection of natural history specimens, which he bequeathed to the St Andrews Museum. He was elected a fellow of the Society in 1838.

Silas Palmer was a native of Stirlingshire. He prosecuted his medical studies at the University of Edinburgh, and received the degree of M.D. in 1836, on which occasion he presented a Thesis on Consumption. He was also a licentiate of the Royal College of Surgeons. He prosecuted his studies also in Paris, Vienna, and Rome, and afterwards settled as a medical practitioner in Newbury, Berkshire. While he studied in Edinburgh, he became a member of the Royal Medical Society. He was also a fellow of the Royal Society of Antiquaries, of the Royal Medico-Chirurgical Society, and of the British Archæological Association. He was the author of articles in the "British Archæological Journal," in the "Lancet," and other periodicals. He joined the Society as a Resident Fellow in 1837.

David William Roberts was born in the parish of Llanelidan, Denbighshire, on 23d December 1845. He was educated in the Grammar School at Ruthin. At the age of 16 he was admitted into the Chester Infirmary as an apprentice, where he remained for three years. He then prosecuted his medical studies at the University of Edinburgh, and obtained the degrees of Bachelor of Medicine and Master of Surgery in 1869. Two years afterwards the degree of M.D. was conferred upon him. He was appointed House Surgeon to the Carnarvonshire and Anglesea Infirmary, where he remained for about three years, and then removed to Llanfairfechan, where he practised with success for two years and a half, when he

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was obliged to retire on account of ill health. He had frequent attacks of hæmorrhage from the lungs, which ultimately led to his death, suddenly, on 4th March 1875. He joined the Botanical Society in 1865.

JOHN TATHAM died at Settle, on 12th January 1875, aged 81. He joined the Society as a non-Resident Fellow in 1841, and contributed to the Herbarium.

GUSTAVE ADOLPHE THURET, an Honorary Fellow of the Society, was born in Paris, 23d May 1817, and died from *angina pectoris*, at his house at Antibes, on 10th May 1875. He was one of the most distinguished botanists and horticulturists of France. He devoted special attention to the structure and physiology of Algæ. One of his earliest papers was on Antherozoids of Chara, published in 1840. He detected Cilia in this order. He described the Archegonia and Antherozoids of Fuci in a memoir, in which he was assisted by Decaisne. The fertilisation of Algæ occupied much of his attention, and he published admirable papers on that subject in the "Annales des Sciences Naturelles." He was a man of independent means, and lived on his property at Antibes, on the shores of the Mediterranean. His garden was a remarkable one, and contained a most valuable and varied collection of plants from all parts of the world.

The following communications were read:—

I. *Note on the Discovery of* Naias flexilis (Rostk) *in Perthshire.*—By DAVID C. ROBB, B.A., Worcester College, Oxford.—Communicated by JOHN SADLER.

On the 13th of August last, in company with Mr Abram Sturrock, parish teacher of Rattray, I visited the Loch of Clunie for a day's botanising. In the course of the day Mr Sturrock dredged from the loch, among a dense mass of *Callitriche autumnalis*, a fragment of a plant which looked different from the rest, and which on closer examination was found to possess fruit different from that of *Callitriche*. On a critical examination afterwards the plant appeared to be

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Naias flexilis; but inasmuch as this plant had not, so far as we were aware, been observed anywhere in Britain before, we were rather doubtful about the accuracy of our diagnosis. A subsequent reference to Bentham's plates put the matter beyond a doubt. The plant was subsequently gathered in larger quantities, and both male and female specimens were found.

The Loch of Clunie is about five miles west of Blairgowrie, between Butterstone and Marlee Lochs, on the road to Dunkeld. Its surface is 157 feet above the sea.

Clunie Castle was the birthplace, or at least the early home, of "the Admirable Crichton." Besides this historical interest, the loch possesses great natural charms, and is particularly noteworthy in a botanical point of view as containing many aquatic treasures, such as *Isöetes lacustris*, *Elatine hexandra*, *Lobelia Dortmanna*, *Subularia aquatica*, *Nuphar luteum*, *Nymphœa alba*, &c.

Naias flexilis appears to be pretty well diffused in the loch. It seems to thrive only on a gravelly bottom, never less than five or six feet under water. We have generally seen it in company with *Callitriche autumnalis*, from which it requires a practised eye to distinguish it when growing in the water. It is of a richer green than *Callitriche* and nothing really can exceed the marvellous beauty of six feet of Clunie's water with the graceful *Nymphœa* on the top, *Callitriche* and *Naias* below, and the sun shining warm through it all.

I cannot, however, conclude this note without a word of caution. I have mentioned the presence of several good plants in the Loch: it further contains, or did contain, *Butomus umbellatus* and *Stratiotes aloides*. But these plants are not natives of Scotland, and if any one will refer to Hooker's "Old Flora" they will find them set down as having been introduced into Clunie Loch by the late Rev. Mr M'Ritchie. Now, Mr M'Ritchie's botanical days were over before Professor Oliver found the *Naias* at Connemara. At any rate, as far as we can learn, it was from Wales Mr M'Ritchie brought his plants, so that unless we succeed in finding *Naias* elsewhere in the neighbourhood, I shall be inclined to conclude that it had also been unintentionally introduced; and that stations for it, at least in Wales, ought to be discovered.

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This, of course, is no more than probable, for as the plant is stated to have been observed in a few *scattered* localities in Europe, there is no inconsistency in its being found in a few *scattered* localities in the British Isles.

II. *The Autumn Tints of Trees.*—By JAMES M'NAB.

October is the month when the foliage of trees exhibits the greatest variety of rich colouring. The leaves of some trees, however, as the Ash, Walnut, Elder, &c., only assume a dingy green tint. On October 30, many trees had not lost their foliage, and in some cases it was quite green. Amongst these were the Oriental Plane, *Alnus cordifolia*, *Quercus fastigiata*, *Sorbus vestita*, *Rhamnus catharticus*, and others with smooth leaves. In these cases, however, the leaves eventually fall off more or less coloured. Other trees then in leaf, but with the foliage more or less hairy, generally fall off in their green condition, such as *Celtis occidentalis*, black and white Mulberry, common Fig, *Catalpa syringæfolia*, &c.

During the whole of October this year the tints of foliage on ornamental and forest trees in Edinburgh have been highly interesting. Some of the leaves had a rich crimson or red hue, some exhibited shades of brown and yellow, while other had all these tints more or less on the same tree, such as the Sugar Maple, Liquidambar, and the Virginian Creeper. The Tulip tree, when it begins to fade, has its leaves equally divided between green and yellow. Afterwards they all become quite yellow, in which condition they remain for eight or ten days, and ultimately assume a darkish brown hue, before they fall off. During October the yellow tints were the most prominent on the *Acer monspessulanum*, *A. campestre*, *Cratægus heterophylla*, *Æsculus Hippocastanum*, *Quercus conferta (pannonica) Q. pyramidalis*, *Mespilus grandiflora*, *Carpinus Betulus*, *Betula alba*, *B. pontica*, *Castanea vulgaris*, *Sorbus Aria*, &c. Some species retain their leaves for a long time in their coloured condition, while others fall immediately on assuming the yellow tint, as observed on the various species of Lime and Wych Elm. When leaves assume a dark red or deep brown hue, they generally remain much

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longer on the trees than those having yellow tints. This is observed in the American Oaks, particularly the *Quercus rubra*, also in *Amelanchier vulgaris*, and some varieties of the common Beech.

The ordinary Purple Beech generally parts with its leaves early, and when going off the colour resembles the decaying foliage of some of the green Beeches, particularly the thick-leaved sorts. A variety of the purple-leaved Beech, not uncommon in the gardens at Corstorphine, near Edinburgh, has its leaves in spring of a greenish tint; during summer they are of a rich dark purple; towards autumn they again assume a greenish hue, and ultimately fall of a dark brown colour, not unlike the green varieties. The tree, however, retains its leaves much longer than the ordinary purple form.

The well-known Corstorphine Plane, *(Acer pseudo-platanus* var. *lutescens)* during the spring months has a conspicuous yellow foliage. During the summer the leaves become as green as those of the ordinary *Acer pseudo-platanus*. In autumn no difference is observed from the ordinary typical species. In the variety cultivated under the name of *Acer pseudo-platanus* var. *purpureus*, the purple tinge peculiar to the under side of the leaf only becomes conspicuous during summer. When the leaves fall from the tree in autumn, the purple tinge is distinctly visible, although the upper surface of the leaf has the greenish yellow hue peculiar to the typical species.

The silver or variegated *Acer pseudo-platanus*, in spring has its foliage of a pale green colour; during early summer the variegated or white portions become distinctly visible; when the leaf falls in autumn the variegated parts are of a golden or yellowish hue, and the green portions are of the dingy yellow-green colour common to the species.

Cratægus Oxyacantha var. *lutescens* comes out in spring of a rich yellow, and continues so for many weeks; during summer the leaves become perfectly green, and were so on October 30.

The Scotch Laburnum was noticed in my report for July as having the points of all the top shoots of a rich golden-yellow, contrasting well with the dark green leaves; the trees have now a golden-yellow tint, but no leaves have yet

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fallen (Oct. 30). Although no flowers were produced in the garden on the Scotch Laburnums this year, the trees have made up for the loss by the charming masses of tufted yellow foliage, particularly when seen growing in a position where the rays of the setting sun have access to them. A similar effect is also produced in this tree during some years when covered with fruit, which hangs down in thick yellow-green masses, long before the ripening of the seed.

The foliage of the *Pavia flava* and *Amelanchier vulgaris* has been remarkably fine this autumn, as they retained their coloured leaves longer than most other trees. The former was of a rich yellow colour, while the latter was of a deep red hue. As both appear in perfection about the same time, they ought to be extensively cultivated as foreground trees, with the view of producing landscape effects in autumn.

During the month of August many leaflets fell from the Locust trees *(Robinia pseudacacia)*, all of a deep yellow colour, as noticed in my report on vegetation for that month. In September the foliage of the Robinia assumed a peculiar blue-green tint. In due time they fell off, of a dark green colour.

Owing to the rich and varied tints, and the peculiar circumstances attending the change in colour of the foliage of certain trees, it would be highly desirable to have some eminent chemist to analyse the fluids contained in the leaves, so as to furnish an explanation of the various colours which many of them generally assume.

Although the tints of the arboreous vegetation at Edinburgh have this year been remarkably fine, it does not follow that the same varieties show the same richness of colour in other soils and situations. During a recent tour through several counties of England and Ireland (early in October) I was surprised to find many varieties of the trees here enumerated in their normal green condition, although many were coloured at Edinburgh before I left. Being further south, and therefore better ripened, I certainly expected to find the autumn tints more advanced than in Scotland. Perhaps this may be accounted for by the comparatively dry weather experienced at Edinburgh during the summer. Although showers were frequent here, the

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under-stratum or subsoil has been excessively dry, owing to the rains not being sufficient to penetrate.

Nothing could exceed in richness the foliage of the Virginian Creeper as seen in many parts of England this autumn, more particularly on the old College and other buildings at Oxford. The *Ampelopsis Veitchii* and *A. trifurcata* were also gorgeous in several places, but they are not cultivated to the extent they justly deserve.

November set in with much rain, attended with high winds, and afterwards severe frost, which has quickly denuded the trees of their leaves.

9th December 1875.—W. B. Boyd of Ormiston, in the Chair.

The following Communications were read:—

I. *Observations and Experiments on Ergot.* By A. Stephen Wilson. (Plate V.)

The present paper does not propose any microscopic examination of ergot, or of the structure of the fungus growing from it. Indeed the drawings and descriptions of Tulasne (*Annales des Sciences Naturelles*, 1853) leave little regarding structure to be added. The fault of Tulasne's drawings is, that they are too fine. He has made a neater job of the Claviceps than Nature has done. For example, his vertical section of the hymenium shows a symmetrical arrangement of conceptacles all round; but as these conceptacles are scattered irregularly over the head, no section can cut them all through the centres at equal distances apart. The section of the head, either vertical or horizontal, is as in fig. 3.

What is here intended is simply to set down such facts in the life-history of ergot as seem to hold true in the locality in which they were observed.

In those parts of Aberdeen and Kincardine shires here referred to, about twenty of the grasses are usually ergotised. (See Appendix No. 1). In what way ergot has

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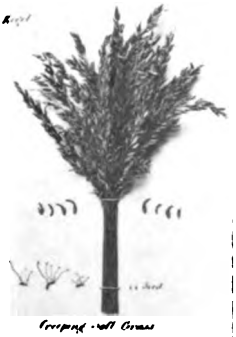

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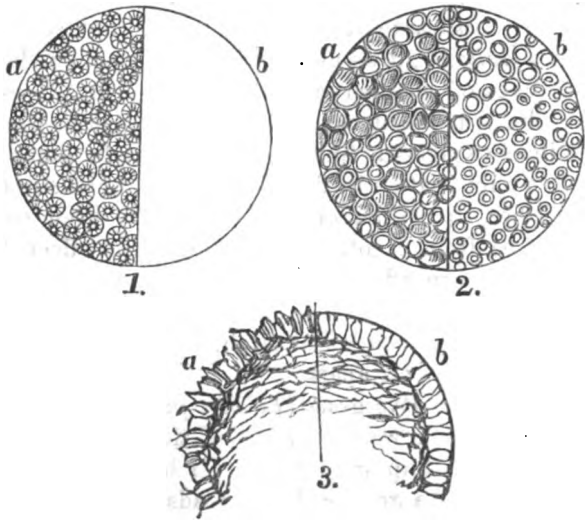
come to be specially associated with Rye, I do not know; at the present time, in the places named, ergot is nearly as rare upon Rye as upon Barley. Year after year, I have searched fields of Rye, without finding more than a very few spurs; some fields yielding none. The first ergot found by me on Rye was on a plant of twenty-four stems in the garden, at a great distance from any point which



1. Claviceps seen in plan. *a* ripe; *b* unripe.
2. Transverse sec. through centre of conceptacles. *a* ripe; *b* unripe.
3. Vertical section through conceptacles. *a* ripe; *b* unripe.

had ever been known to bear Rye; the strong probability thus being that it was produced from the Claviceps of some of the common grasses.

But if in remote times, or in other localities, or other countries, ergot is or was much more prevalent on Rye than in the places named, certain conditions must be different. Are these conditions botanical, agricultural, or meteoric? In June last, the Canterbury Agricultural Association of New Zealand offered a prize of twenty guineas "for the best essay on the recent appearance of ergot in Rye and other grasses, and on the best mode of preventing and curing the disease." Probably the ergot has been carried with grass or Rye seed to New Zealand, and has there found

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conditions favourable to its growth and multiplication. What these may be will be considered below.

Grasses most Subject to Ergot.

The grasses which are most liable to ergot are the Floating Meadow-grass (*Glyceria fluitans*, R. Br.), the common Rye-grass (*Lolium perenne*, L.), the Cat's-tail grass (*Phleum pratense*, L.), Soft-grass (*Holcus mollis*, L.), Vernal-grass (*Anthoxanthum odoratum*, L.), and some others. *Glyceria fluitans* grows mostly in the sides of ditches, or in wet patches of untilled meadow ground. In places of this sort I have found it covered with ergot. But the notion, sometimes expressed, that ergot is caused by damp, is seen to have no foundation by finding *Glyceria fluitans* in recently cut ditches, to which ergot has not yet been conveyed, wholly free from ergot. Places which are affected in one season are more affected the following season than other spots in the same district. I have seen this grass thickly ergotised at one end of a ditch, and wholly free at the other, not 100 yards apart.

The common Rye-grass (*Lolium perenne*) is ergotised in all situations—in waste corners of fields, on public roads, and on dry or damp arable land. I have found it in great abundance on the green sides of roads. In such situations it appears that the florets of this grass are much exposed to the floating spores. The Rye-grass of the hay crops is never effected in the least, simply because it is past flowering before the Claviceps is ripe.

I have found the Cat's-tail-grass (*Phleum pratense*) much ergotised along the margin of the River Don. In cases where the spikes have been bent down to near the ground ergotising is most severe, showing apparently that the spores are most numerous in the lowest stratum of the air; indeed, it is a fact in all cases that the nearer the spike or panicle is to the surface of the ground, the more it is ergotised. This may partly explain the greater prevalence of ergot on the short-strawed Continental Rye.

The Vernal-grass (*Anthoxanthum odoratum*) is most ergotised in shady places, in woods, or in the north border of woods.

The Mat-grass (*Nardus stricta*) is ergotised in woods,

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and also on open heathy moors, where no shadow falls upon it.

The Soft-grasses (*Holcus mollis* and *lanatus*) are ergotised everywhere, but to the greatest extent amongst rank grass in places somewhat shady.

The Reed Canary-grass (*Phalaris arundinacea*, L.) I have found ergotised only by the edge of the Don.

Wheat and Barley are very rarely ergotised, and on none of the cultivated Oats (*Avena sativa*, L.), or the wild Oats (*A. fatua*, L.), or the bristle-pointed Oats (*A. strigosa*, Schr.), or the Fly Oat (*A. sterilis*, L.), have I ever seen a single case of ergot. The Dog's-tail-grass (*Cynosurus cristatus*, L.) has never afforded a case of ergot in the localities observed, though it abounds and is mixed up with grasses much ergotised. Various species of Bromus are also proof against the ergot spore. Mr Carruthers mentions (Journal of the Royal Agricultural Society of England, vol. x., part ii., 1874) amongst the grasses most subject to ergot, *Bromus secalinus*, L.; *B. mollis*, L.; *B. pratensis*, Ehr., but without stating the locality where those grasses are affected. This is a point which deserves to be looked into, since if a grass —whether *Bromus*, Dog's-tail, or cereal Rye—is ergotised in one country, and not in another, some important fact will come out in the explanation.

Relation to Season.

The time of the year at which the grasses begin to be ergotised depends on the time at which the Claviceps is ripe. On May 25, 1874, I found a great many spurs of *Glyceria fluitans* in the sides of a half-dry ditch, below decaying grass. At that time scarcely any of them had begun to produce the fungus; but, laid on a damp cloth between two plates, they nearly all in a few days began to show signs of growth, and in a fortnight were covered with beautiful specimens. On June 9, I examined the same ditch, and nearly all the ergots I found had fungi upon them in an early stage of growth; the weather having been very dry, and apparently supplying too little moisture for vigorous growing. A few ergots of *Holcus mollis* found at another place at the same time had also the young fungi beginning to make progress. By June 27, the fungi

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in the ditch had made considerable advance. Some of them were nearly ripe, with stems of half-an-inch in length, but most were not nearly so far advanced. A month later, on July 25, they had attained their final size, some being upwards of an inch in length. The grass beside them was in flower, with some of the florets ergotised. On June 24, 1875, the fungus in the same ditch was more than an inch in length, but although the grass was then in flower none of the florets seemed to be yet attacked.

It would, therefore, appear that in the north-east of Scotland ergotising begins after the middle of June. The latest case of ergot in an early stage which I have noticed, was the middle of September. But the fact that the artificial application of moisture brought the Claviceps to maturity, shows that when the early part of the summer is damp and warm, ergotising may take place sooner than when it is dry.

It is almost invariably the case that ergotised spikes or panicles have flowered late. None of the spikes of the Vernal-grass which come up early are ergotised; no spores are floating abroad when they are flowering. As already noticed, the hay crops are past flowering before the sporing season has begun; but the spikes of *Lolium perenne* which come up late, and stand solitary or in little groups in field or road, are sure to fall victims.

To what cause the greater prevalence of ergot on cereal Rye in some parts of the Continent is attributable is a question quite within reach of observation. Tulasne observes that in 1852 it was easy to collect at Beaumont-sur-Oise and in the vicinity of Paris and Versailles, abundance of ergotised grasses, the ergots of each of them in all states of development in the middle of summer; which would seem to show that, in France, the time when the Claviceps ripens holds a different relation to the season from that which it holds in Scotland. In Scotland no ergot is to be found on the grasses so early as the middle of summer. The greater prevalence of ergot on Rye in France is probably to be thus explained—by the earlier maturity of the Claviceps; it must there be ripe while the Rye is blossoming, which is only the case to a small extent in Scotland. If the Rye in Scotland opened for fertilisa-

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tion a fortnight later than it usually does, or if the ergot fungus was ripe a fortnight earlier, more ergot would grow upon Scots Rye. It is not certain that in the old husbandry of this country the cereals fertilised at a later period than they do at present. In Tusser's time Rye began to be sown in September, but it was also sown in several of the following months, while Barley was sown as late as May; but autumn and spring-sown Rye flower about the same time, unless where the spring sowing has been late. But it is certain that in the old husbandry the quantity of grasses which infested the corn lands was much greater than it is now. Under June Tusser advises:—

> "Now down with the grass upon headlands about,
> That groweth in shadow so rank and so stout;
> But grass upon headlands of Barley and Pease,
> When harvest is ended, go mow if you please."

And when all the appliances of modern tillage have not been able to extirpate Couch-grass (*Triticum repens*) and Oat-grass (*Arrhenatherum avenaceum*), we may be sure that these and other grasses laid claim to a large proportion of the old corn lands. The Oat-grass is one of those most subject to ergot. The large area of uncultivated borders and waste pasture land in early times also afforded greater facilities for the undisturbed growth of the Claviceps, while the want of drainage afforded that half-dry, half-damp bed most favourable to the growth of this fungus.

Now, one question here is, which circumstance is it which is favourable to the recent growth of ergot in New Zealand, and which is it that favours its growth on the Continent?

One point seems certain, and affords a starting-ground for inquiry—wherever ergot is prevalent on any grass, there that grass fertilises simultaneously with the dissemination of the spores of the ergot fungus. If a climate somewhat warmer than that of Scotland brings the sporing of the ergot fungus and the flowering of cereal Rye into necessary contemporaniety, there is probably no cure in that place for ergot upon the Rye. Since, if in Scotland, where cultivation has drained the land and laid hold of the waste places, there is still a great deal of ergot on the forage grasses, and patches of wild grasses sufficient for

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nurseries; much more are there nurseries and damp, uncultivated grass lands in countries of a less advanced agriculture. The ploughing down of grass lands every few years in the course of rotation buries a great deal of ergot, which is thus entirely destroyed. Where land is permanently in pasture, and the grasses of a kind which throw up seed-bearing spikes, the ergot has full opportunity of multiplying.

We thus get some glimpse of the reason why the disease called ergotism was more prevalent in former states of agriculture than in the present state.

In Mr Carruthers' paper referred to, allusion is made to the differences of opinion which exist in regard to the kind of season most productive of ergot. "Edward Carroll, observing in Ireland, says ergot is more frequent in dry than in wet seasons;" on which Mr Carruthers observes, that this reversing of English and Continental experience is probably due to the normally moist atmosphere of Ireland. I have found ergot more prevalent in Aberdeenshire in a dry season than in the following wet season. The times are noted above at which the fungus is usually ripe. A certain amount of moisture is required while the fungus is growing, in order to bring it to maturity at a certain date. If this moisture is defective, the date of maturity will be retarded; but now when the fungus is ripe, and the mouths of the conceptacles have risen above the general surface, the question whether wet or dry weather is favourable to further processes depends altogether on the character of the spores, and the agencies by which they are scattered.

The hymenium of a Claviceps from the ergot of *Glyceria fluitans*, of one-twentieth of an inch in diameter, contains about 3000 conceptacles, or bladder-form sacs of needle-shaped spores. Before the fungus is ripe the surface of the head is smooth, but as it ripens each conceptacle rises in a projection above the surface a height equal to the breadth of that part of it which appears as a brown papilla. This breadth is about ·0018 of an inch, while the distance between the papillæ is about ·003 of an inch. The spores of this fungus seem in general to consist of but one long cell, though sometimes they are septate. Sometimes they

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are ·0075 of an inch in length, but for the most part only about ·0046 of an inch. The length is about eighty times the diameter.

Mode of Dissemination.

Some of the modes of the dissemination of spores are noticed in Cooke and Berkeley's recent work on Fungi (ch. vi.). The mode peculiar to the present spore, and perhaps to others of the same character, seems to differ a little from any of these.

It might be inferred that a spore which comes in contact with a grass floret, raised from 1 foot to 5 feet above the ground, cannot be conveyed by water or rain. But a direct observation is generally better than an inference.

I placed a large number of ergots, with many ripe fungi growing upon them, in a clear bottle, on a piece of wet cloth, and held them up in the bright sunshine. Very soon a conceptacle here and there began to deliver a shower of arrows right out into the air. Placing a black background to the bottle, the flights of bright needles could easily be seen with the naked eye, coursing through the bottle like shoals of minnows in a clear pool; now to the right, now to the left, then upwards or downwards, as if under the influence of forces different from any air eddies which might be supposed to be moving in the corked bottle. It is most probable, however, that currents of vapour were being raised from the wet cloth, and giving the variety of motions. When the heads became dry the discharge of spores ceased. With an eye-glass they could be more closely watched. Some darted, or were shot out with great rapidity; but after a time, on a papilla here and there, the spores merely wriggled out and fell over on the surface. The process went on for hours, and, from the large number of ergots enclosed, was ready to show itself again for several days.

What the cause of projection may be is conjectural. The conceptacles and the papillæ seem to be filled with a brown jelly. Now, the rising of these papillæ from a previously flat surface shows that a growth is going on, and a consequent pressure increasing in intensity. So that when the ripe heads are exposed to a certain heat, the

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tension is brought to a crisis, and the spores are projected by elastic pressure. Necessarily when this pressure begins to abate by the relief consequent on a continuous discharge, the spores are not acted upon by so great a force as at first, and this seems to explain why the last spores, instead of being shot into the air, are merely pushed slowly to the surface and fall over. Indeed, it is almost certain that a good many spores are never ejected at all, but perish with the decaying fungus.

There is a certain analogy between the discharge of these spores and the discharge of the pollen in grasses. In both cases the first discharge appears to result from an internal pressure producing sudden rupture.

Relation to Climate.

It will now be seen that as the spores which produce ergot are thrown out copiously in bright, warm weather, and are carried by the air, lifted up from the damp places where they grow, by atmospheric motions caused by ascending vapour, a dry season at the time of sporing is favourable to the production of ergot. Damp weather is necessary for the ripening of the Claviceps, and dry weather for the dissemination of the spores. But a whole season is not involved; a bright day now and then, while the grasses are opening and these sphæri sporing, is sufficient for the production of ergot. The notion that a wet season is requisite to the development of ergot has perhaps usually contained the implication that ergot is a disease, or a kind of rotting of the grass ovary. It is neither the one nor the other, but the first form of a parasitic plant.

That there may be a large crop of ergot in any year, it is necessary that a considerable quantity of ergot should retain its vitality from the previous autumn; but, although in July and August there may be numerous spores in the atmosphere, yet, if the season has not been sufficiently damp to make the grasses tiller and throw up late spikes, there will be fewer florets to be ergotised. A season which is at once favourable to the Claviceps, and to the production of late-flowering grasses is, in this country, demanded for the largest development of ergot; but the quantity of ergot which may be gathered almost any autumn on the

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various grasses in Scotland, would probably be equal to the home demand. The smaller ergots are more compact and less fractured than those of cereal Rye, and contain fewer of the eggs of flies, and would probably better preserve whatever qualities they possess. If these smaller ergots have not been tested in medical practice, they seem to be worth a trial.

Various Forms of Ergot.

The form and size of the ergot of each grass are peculiar to that grass. It would be easy to tell that this ergot grew upon *Nardus stricta*, and that upon *Anthoxanthum*. The heavier spurs on Rye weigh from 3 to 5 grains, coming up to ten times the weight of the Rye kernel. But many ergots on Rye and other grasses do not project beyond the pales, nor show themselves to a cursory inspection. The weight of a kernel of Vernal-grass is ·011 of a grain. The weight of the ergot of this grass is sometimes, even when very dry, ·4 of a grain, or 36 times the weight of the kernel. The seed of *Glyceria fluitans* weighs ·036 of a grain, while its ergot will sometimes weigh 1·02 grains, being 28⅓ times the weight of the ripe seed. On *Poa pratensis* the ergot is about one-hundredth of a grain in weight. See Pl. V.

Mode of Action.

The ergotising of a grass floret takes place at or a little after the time of fertilising. It has been stated that the ergot often carries on its apex a cap formed of the agglutinated anthers and stigmas. This would imply that ergotising may take place before fertilising; because the moment that fertilisation takes place, the anthers are pushed up by the filaments beyond the possibility of ever being involved in the ergot. The filaments are usually longer than ever the ergot grows, and the anthers are usually broken off before the ergot emerges from between the pales. That the stigmas are sometimes involved there can be no doubt, but I have never seen a case in which the anthers were retained. In many cases there is a contracted gray point on the mature ergot, having the appearance of agglutinated anthers; but if these ergots are observed at an early stage when they are only just coming from between the pales,

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and are still a soft white mass, nothing like anthers of stigmas project from the apex. The contracted points shrivel up, apparently because they are not fully injected with spermatia.

Soon after the spore has planted itself in whatever part of the floret it selects or falls on, the glitter of a fluid on the pales points out where the young ergot is in deadly conflict with the living cells of the ovule. Gradually the fluid increases to a drop and a "blob." At the bottom of this blob a deposit of spermatia accumulates, exuded from the growing ergot. But it seems a mistake to suppose that the fluid also is exuded from the ergot. The quantity is so large and continuous that absorption from the air seems the true explanation.

On Artificial Ergotising.

Some spikes of newly flowered Rye were inserted and turned round and round in a test tube containing many ripe heads from the ergot of *Glyceria fluitans*. Probably thus inoculated in a few days drops began to appear. The ears were then tied to a stake and inserted in a clear bottle, through the neck, with the bottom partly out. This protected the ears from wind and rain, and so allowed the drops to attain their full size before being carried down by gravity. They were collected, however, every morning with a dropping tube and put into a small phial.

It is stated by Mr Carruthers that the striking of one ergoted ear in the early stage upon another will communicate the disease, and that this has been experimentally tested by Bonorden and confirmed by Roze. In this operation I have not yet been successful; although carrying part of a drop to newly fertilised flowers none of them were ergotised. If the matter of these drops is capable of producing ergot, why does it often happen that a single floret on the upper part of a spike is alone ergotised, the drop running down producing no effect on the lower florets?

Still, I am not in a position to deny that the granule in these drops may be a vital spermatium. The drops on the spikes of Rye in my bottle were persistently visited by about six species of Diptera, for which they seemed to have a great attraction, the strong smell of these drops bringing

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flies I had never observed in the place before. Other two spikes of Rye close beside, but not in the bottle, now showed drops upon them. Perhaps it is possible these had been inoculated by the flies. It would be altogether unwarranted to affirm that spermatia carried by the flies produced ergot. All that is yet certain is that the flies went constantly in at the neck of the bottle, or at the openings of the paper which covered the broken bottom, and sucked or drank part of the fluid on the ears. Three Barley florets which I had ergotised by applying the spores of the Claviceps of *Glyceria fluitans*, and which stood in the house in pots, were also, when in the fluid stage, constantly visited by the house-fly. During this time a fly fell dead on the paper before me, and others I found dead about the windows. I do not know that they died from the ergot fluid, I only know that they drank it. A question is thus opened bearing upon the effects of fungi on flies.

Two of the florets of Barley which were probably ergotised artificially, produced large spurs, while one which showed the drop for six or eight days seemed to have simply been killed without producing an ergot—suggesting the notion that possibly the production of an ergot requires a certain amount of growth in the grass embryo to give it that start which shall eventuate in a complete ergot. None of the spurs on the Rye in the bottle was of large size, although the blobs of fluid were enormous and renewed night after night as they were removed. Perhaps the removal of these every morning was inimical to the growth of the ergot. In various florets which produced drops, no ergot followed.

Several methods of producing ergot were tried. Little bits of the ripe heads of the fungus were placed on newly-opened florets. In two cases these killed the ovule, producing red drops but no ergot. In other cases the young embryo was thus killed without producing any drop or any ergot. Various Wheat embryos were killed, but no ergot produced. Probably the quantity of spores was too great, or the rotting of bits of the fungus interfered with the expected result. I believe I succeeded in ergotising half a dozen florets of *Glyceria fluitans* with spores from its own Claviceps, on an isolated tuft, and on which there had not before

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been any ergot. Many florets were tried with the spermatia from the drops, and although in this case one can be quite sure that the granules are actually applied to the floret, no ergot was thus produced. Reserve is prudent in any assertion of artificial inoculation. I do not know in any case how certainty can be attained, that a floret which has had spores applied to it may not also have been naturally acted upon by sporules from the air. The gray matter or spermatia which exudes from the young ergot and runs down the spike, seems to give rise to fungi of the mould tribe; but I have not seen a case where it thus produced ergot.

In order to grow the Claviceps, the ergots may either be thrown upon earth in a saucer and half covered with withered leaves, watering occasionally, or be placed on a damp cloth between plates. Some of them will soon get covered with mould, and will never produce the Claviceps. Perhaps these are dead, for others close beside them will remain untouched by mould, black and shining, till they burst into a crop of the true fungus.

Is there More than One Species?

But the identity of ergot, says Berkeley (*Introduction to Cryptogamic Botany*, p. 282), with Cordyceps has been called in question by Cesati, because two species occur occasionally on the same kind of ergot, in deprecation of which, says Berkeley, it is very possible that the same grass may be ergotted by more than one Cordyceps; and even should a single ergot be found to produce two species at once, it is possible that the sporidia of the two species may have concurred in its production. The writer and others have submitted to Mr Berkeley ergots with the *Claviceps* upon them, which he has found to be of the species not usually growing on these ergots—*purpurea* where it should have been *microcephala*, and the converse. The truth seems to be that there is only one species of ergot fungus. Tulasne's definition of *purpurea* includes a villous base. An ergot of Oat-grass is before me in which two stipes beside each other are very hairy at the base, while five others on the same spur are entirely without hairs.

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Growth of the Fungus.

All through the winter below the rotting grass on which they grew, the ergots lie black and free from mould, subject only to ants and other unpoisonable enemies, which scoop out cavities in them or bore holes through them. Swarms of black ants I have seen visiting the ergot while it still remained on the grass. The least bit of an ergot will produce a fungus. The first sign of vitality is the rupturing of the black cuticle of the ergot. Generally the half-formed head pushes aside the black skin and shows its whitish purple above the surface. The fungi grow out from all sides of an ergot, while the number which one ergot may produce is indefinite. Sometimes only one is produced; sometimes two, three, four, or other numbers. A home-grown Rye ergot produced twenty-three, all from one side —the upper side as it lay on the surface of the damp earth. In growing, these thin-stalked fungi incline towards the light, perceiving very well through a plate on which hand the window lies. The stems are of all lengths up to rather more than an inch and a-half. Tulasne seems to have attained only a length of from 15 to 25 millimetres; some of mine have been 40 millimetres, and frequently they are longer and thicker on the ergot of *Glyceria fluitans* than on that of cereal Rye. Sometimes an amorphous mass grows up without stalk or head; sometimes the base of the stalk is villous, and sometimes bare on the same ergot. For the most part they grow solitary; sometimes two or three come out near each other, but the connection seems merely local. Certain points in the mass of mycelium composing the ergot are more vital than others, and at these points growth takes place, and probably withdraws vegetative force from points immediately around it. The fungi are of various sizes on the same ergot. The stipe is sometimes $\frac{1}{12}$ of an inch in diameter, and sometimes half as much or less. The heads where twenty-three grew together were about $\frac{1}{16}$ of an inch in diameter, and the stems about half as much. I have grown the Claviceps on the ergots of eleven species of grass (see appendix), and the most delicate of them is that on *Aira cæspitosa;* the head being $\frac{3}{100}$ and the stem $\frac{1}{100}$ of an inch in diameter, and rather less than half an inch in length. See Pl. V.

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Looking at hundreds of them growing naturally in the sides of a ditch, it is seen that various shades of colour characterise them; apparently referable to age and exposure to light. The Claviceps which grows in a hole is less ruddy than that which grows from the ergot of the same grass on a ledge having less moisture and more light.

If, as some have conjectured, the spores were carried up the plant with the sap, no obvious reason exists why Wheat and Barley, which are ergotisable grasses, should not everywhere be as frequently ergotised as cereal Rye. But if the spore attacks the floret from the atmosphere, then the character of the floret will be a determining element in the frequeney of inoculation.

Relation to Structure of Flower.

The structure of many grass florets and their mode of fertilisation render them especially liable to the floating spores of the ergot fungus. When a Rye floret opens for fertilisation, the feathery styles are thrown outside the pales on both hands, and are seldom retracted, while in many cases the pales remain slightly ajar after fertilisation has taken place. It is the same with many other grasses—some do not close again after opening for several hours, and in many the feathery stigmas remain permanently exposed till they wither off. In Vernal-grass the mode of fertilisation is peculiar; this grass (in the locality always referred to) never opens out its pales at all, the stigma is exposed before the corresponding anthers, and these anthers are pushed out from between the points of the closed pales. The part, therefore, of this highly ergotisable floret which is attacked would appear to be the upper end of the stigma or the styles. I have observed a very small fly, like the saw-fly, in great numbers, pushing out and in between the close pales of this grass, and it is possible that spores may be thus conveyed to the ovary. The pales of *Glyceria fluitans* open wide for fertilisation, while the feathery styles spread out on both sides. It is the same with others of the more ergotisable grasses.

In the Wheats, again, and in most of the Barleys, the florets are open for a very short time, and to a very slight extent while the feathers are scarcely ever exposed outside

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the pales to the flying enemy. These grasses fertilise themselves, and immediately shut their doors to intruders. It can hardly be, however, that mere mechanical exposure to the spores is all the explanation, because the exposure of the cultivated and wild Oats presents an open floret hanging downwards as if ready to be entered by any spores which may be rising on an eddy of vapour beneath them, and yet none of the Oats is ever ergotised; still, there is reason to suppose that greater mechanical exposure is a large part of the explanation of greater liability to ergot. The species of Bromus which grow here, open very little for fertilisation, and soon close very tightly, and are never ergotised.

Effects Produced by the Ergot.

The question of the effects of ergot upon cattle does not fall to be here considered; besides, not a single fact bearing upon it has fallen under my notice.

But another question suggests itself: What is the effect of ergot upon grasses? Of course, one immediate effect is, to prevent the growth and ripening of a certain proportion of the seeds, and thus to hinder the seminal propagation of the plant; but it is a fact that the ripening of the seeds and culms of the cereal grasses tends to make these grasses more strictly annual. They are not absolutely annual, even when a few spikes on a stool are fully ripened, but grow occasionally, producing ripe spikes from the same stool for two or three years. Now, if before Rye was cultivated, it was so closely ergotised as to prevent all but a few seeds from maturing, the plant may at that time have been a perennial grass; and the present effect of ergot on the grasses may be, while diminishing their seed-bearing capacity, to give a longer term of duration to the roots and lower nodes, than if all the seeds were allowed to exhaust the plant by going to maturity. Probably the balance of the natural grasses is somewhat different from what it would be were there no ergot. The Vernal-grass, which is highly ergotisable, is perhaps encroached upon by the Crested Dog's-tail, which is not ergotised at all; or, if the ergot conserves vitality in the lower nodes, the Vernal-grass may thus hold its own.

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Appendix.

No. 1. *List of Ergotised grasses referred to.*

1. Wheat. *Triticum sativum*, L.
2. Wheat-grass. *T. repens*, L.
3. Rye. *Secale cereale*, Willd.
   Rye. *Secale cereale*, artificially ergotised.
4. Barley. *Hordeum distichum*, L.
   Barley. *Hordeum distichum*, artificially ergotised.
5. Vernal-grass. *Anthoxanthum odoratum*, L.
6. Mat-grass. *Nardus stricta*, L.
7. Foxtail-grass. *Alopecurus pratensis*, L.
8. Reed Canary-grass. *Phalaris arundinacea*, L.
9. Catstail-grass. *Phleum pratense*, L.
10. Turfy Hair-grass. *Aira cæspitosa*, L.
11. Waved Hair-grass. *Aira flexuosa*, L.
12. Creeping Soft-grass. *Holcus mollis*, L.
13. Meadow Soft-grass. *Holcus lanatus*, L.
14. Oat-grass. *Arrhenatherum avenaceum*, Beauv.
15. Smooth Meadow-grass. *Poa pratensis*, L.
16. Annual Meadow-grass. *Poa annua*, L.
17. Floating Sweet-grass. *Glyceria fluitans*, R. Br.
18. Cocksfoot-grass. *Dactylis glomerata*, L.
19. Tall Fescue-grass. *Festuca elatior*, L.
20. Meadow Fescue-grass. *Festuca pratensis*, Hudson.
21. Rye-grass. *Lolium perenne*, L.
22. Darnel-grass. *Lolium temulentum*, L.

No 2. *Grasses referred to on the Ergots of which the Claviceps has been Grown. See Pl. V.*

Wheat-grass. *Triticum repens*, L.
Rye. *Secale cereale*, Willd. (twenty-three fungi on one spur).
Vernal-grass. *Anthoxanthum odoratum*, L.
Mat-grass. *Nardus stricta*, L.
Turfy Hair-grass. *Aira cæspitosa*, L.
Creeping Soft-grass. *Holcus mollis* (also found growing naturally, 1874).
Oat-grass. *Arrhenatherum avenaceum*, Hud.
Floating Sweet-grass. *Glyceria fluitans*, R. Br. (also gathered growing naturally in great numbers in 1874 and 1875).
Cocksfoot-grass. *Dactylis glomerata*, L.
Tall Fescue-grass. *Festuca elatior, F. gigantea* (?), L.
Rye-grass. *Lolium perenne*, L.

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II. *Notes on Monstrosities of* Primula vulgaris, *Huds., and* Saxifraga stellaris, *L.* By Professor ALEXANDER DICKSON.

The abnormal flowers of *Primula vulgaris* exhibited were collected in 1874 at Pitlochrie, Perthshire, by the late Professor Inglis of Aberdeen. The peculiarity consists in the development of five narrow petaloid segments, which alternate with the lobes of the corolla. These narrow segments are not organs simply adherent to the inner surface of the corolla, like "epipetalous" stamens, but their bases form a continuous sheet of tissue with the petals. At first sight the abnormality appears to resemble the doubling of Primroses, often seen in cultivation. In the ordinary double Primrose, however, the additional petaloid lobes are metamorphosed stamens and are *opposite* to (not alternate with) the lobes of the corolla. In the abnormality exhibited, the superadded petaloid pieces are simply interpetaline lobes analogous to the intersepaline lobes in the calyx of *Nemophila*, *Campanula Medium*, &c. One of the most interesting points connected with this is that in the Order Primulaceæ we have a genus, *Soldanella*, in which interpetaline lobes occur. In *S. montana*, for example, the limb of the corolla exhibits five broader lobes, which are trifid, and five narrower ones, which are entire, alternating with them. In this monstrous *Primula* we thus have an abnormal development, imitating, so to speak, the normal condition of an allied genus.

The plant of *Saxifraga stellaris*, from which the specimens exhibited were obtained, was found by Dr A. P. Aitken, on Ben Challum, near Tyndrum. It had three flowering stems, which had about their middle a few scattered narrow bracts, with what appear to be viviparous buds in their axils. Each of these stems is terminated by a monstrous flower, with somewhat numerous sepals in several series, stamens probably about as many, and a vast number of separate carpels, forming an apocarpous gynœcium, almost like that in *Ranunculus*. There seem to be no petals developed. This monstrosity is almost exactly parallel to the monstrous flowers not unfrequently found terminating the inflorescence of *Digitalis purpurea* where we have a

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multiplication of the parts of the floral envelopes and androecium, and a pistil composed often of several whorls of carpels.

13th *January* 1876.—ALEXANDER BUCHAN, A.M., Vice-President, in the Chair.

The following communications were read:—

I. *On the Hungarian Oak* (Quercus conferta *of Kitaibel*) *as Cultivated in the Royal Botanic Garden, Edinburgh.* By Dr MAXWELL T. MASTERS. Communicated by Professor BALFOUR. (Plate VII.)

On the occasion of a visit paid to the Royal Botanic Garden during the summer of the past year, my attention was drawn by Mr M'Nab to a handsome deciduous Oak, known under the provisional or commercial name of *Q. pannonica.* As an ornamental tree it is deservedly a great favourite with that gentleman, who knows how to employ it picturesquely to the best advantage. It was my privilege to "assist at" the removal and replanting of one of these trees in July last, in that speedy and satisfactory manner familiar to those who have had experience with Mr M'Nab's method of transplantation, and with the machine devised by his father for that purpose. In consideration of these circumstances, I may be excused for feeling a kind of personal interest in this Oak, so much so that I felt it a duty incumbent upon me to endeavour to unravel the history of the tree, and ascertain its precise botanical *status.* The results of my researches I now beg leave to submit to the Society; I must, however, speak of it as *Q. conferta* rather than as *Q. pannonica*, as it has been duly registered under the former name, while the latter appellation is a mere commercial or garden name.

Q. conferta forms a handsome round-headed tree of moderate size, with spreading branches and grey, cracked bark. The young shoots are more or less hairy, but become glabrous. The leaves are deciduous, very shortly stalked or

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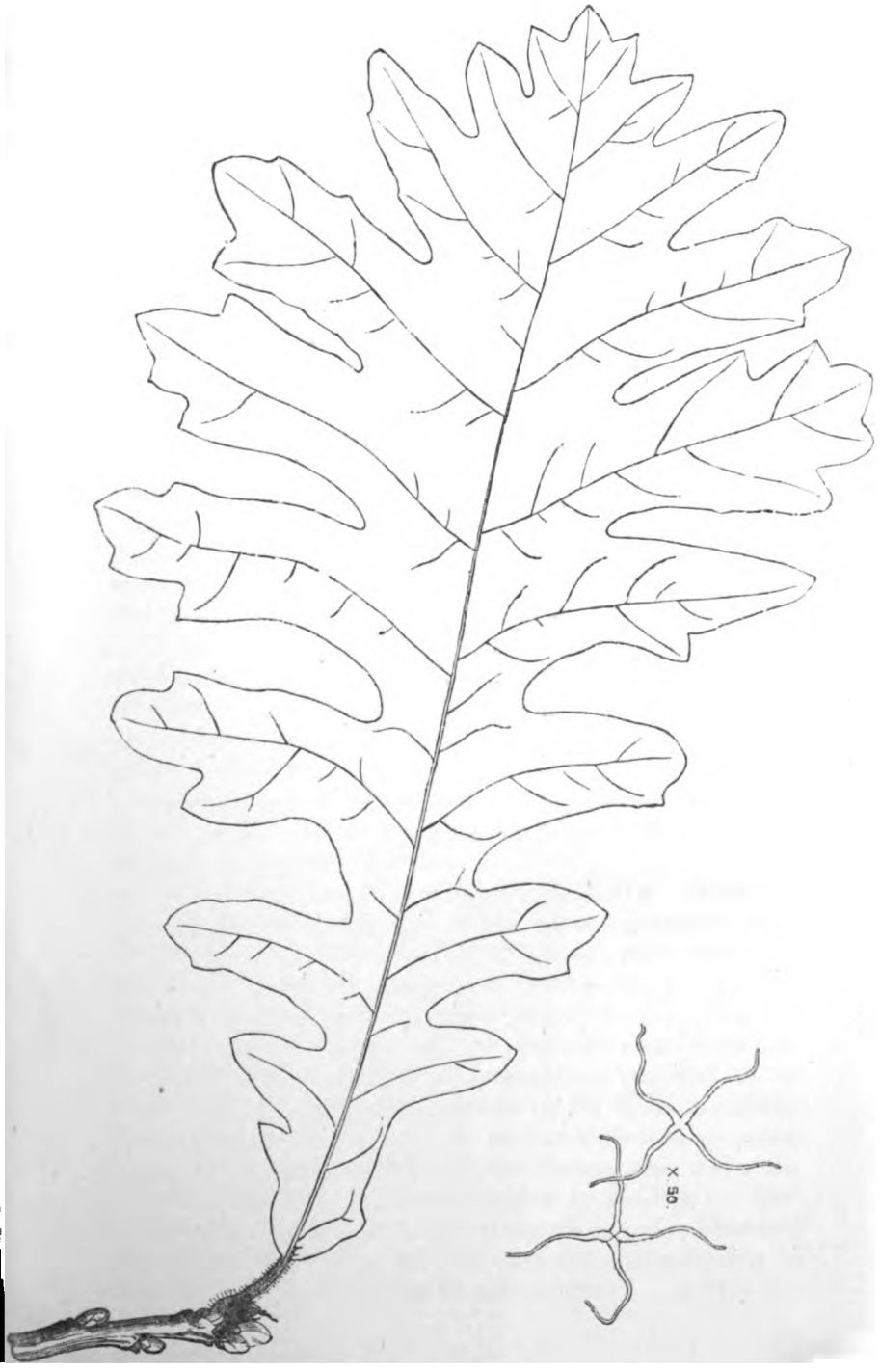

LEAF AND HAIRS OF *QUERCUS CONFERTA*, KIT.

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almost sessile, 5 to 7 inches or more long, 3 to 4 inches broad, membranous, deep-green and glabrous above, pubescent beneath, with stellate hairs. In outline (Plate VII.) they are oblong-obovate, tapering gradually to the cordate base and more abruptly to the somewhat rounded apex, pinnately lobed, sometimes so regularly so as to be almost pectinate; at other times irregularly so as to outline and direction; the upper lobes extend about half-way down from the margin to the midrib, the lower ones rather farther. The lobes themselves are oblong, acute, not spine-pointed, entire, or with a slight tendency to lobulation. The sinuses between the lobes are narrow, linear, acute at the proximal end, somewhat dilated at the distal extremity. The petioles are very short, pilose, channelled on the upper surface, and dilated at the base. The stipules are deciduous, longer than the petioles, pilose, linear-subulate. The buds are elongate-ovoid, pilose, clustered about the ends of the shoots, and sometimes encircled by the withered stipules. Bud-scales oblong ovate, membranous, with a dark edge.

I forbear from giving the characters assigned to the acorns and their cups, as I have not seen fresh specimens of them. They are described in the works cited at the end of this note; and it is for its foliage that the tree will be valued in British gardens.

On applying to Mr M'Nab for information as to the history of the tree, he was kind enough to furnish me with the following particulars:—

"The largest tree in the Edinburgh Botanic Garden of the Oak known as *Quercus pannonica* was procured about twenty years ago from Mr P. S. Robertson, when in charge of Messrs Lawson's nursery at Golden Acre. It was planted in a part of the garden where, judging from its free-growing nature, it could not possibly extend itself into a full-grown tree, and was in consequence removed to its present site in 1865, and planted by Sir William Gibson Craig, Bart., of Riccarton, who at that time took an active share in the arrangements with the Government when the old Experimental Garden was added to the Botanic Garden, and it was the first tree removed into it. This tree is now 20 feet high, and 36 feet in circumference of branches; stem 28 inches in circumference. A very fine

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plant of this Oak is to be seen at Riccarton, where it is a great favourite with Sir W. G. Craig. As Mr Robertson was the first who took charge of this Oak in Scotland, I enclose a note received from him on the subject."

Mr Robertson's note is to the following effect:—

"I first saw the *Quercus pannonica* in the garden of the London Horticultural Society twenty-seven years ago, and in a year or two after that I procured for Messrs Lawson several young plants from Booth's nursery, Hamburgh. I believe all the plants in Britain till 1870 or so were raised from grafts taken from Booth's plants, and grafted in Lawson's nursery. The London tree seems never to have attracted much notice. I was told by Mr Booth (now deceased) that he had it from Hungary, and under the name of *lyrata*, and also *panonacea*; but he fixed on the name *pannonica*, and it has stuck to the plant. I have in vain tried for more than twenty years to get seeds. If a supply of seeds could be obtained in early autumn they would probably grow, but would not do so, I fear, if they arrived later than March."

Loudon mentions that "there is an Oak in the London Horticultural Society's garden which was received from M. Schammes, of Pesth, under the name of *Q. conferta*," and which is doubtless our plant.

Wierczbicki, in a report on a botanical excursion in the Banat contained in the "Flora" for 1842, devotes some space to the description of the tree and to its botanical history. He shows that though Kitaibel's plant was but imperfectly known to botanists, yet that the foresters were well acquainted with the tree; in confirmation of which he cites the titles of a large number of papers in various journals devoted to forestry, but which I have been unable to consult.

In 1860 specimens were submitted to the late Professor Lindley by Mr Thomas Rivers ("Gardeners' Chronicle," 1860, p. 73), with a note on the vigour of the shoots and the magnitude and long persistence of the leaves. Dr Lindley was unable to refer it to any species described in works accessible to him, but he mentions it as probably identical with a species, specimens of which were gathered near Constantinople by Mr Bentham.

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Although, as before said, I have not seen the acorns, yet from a comparison of the leaves with native specimens and with figures, I have no doubt whatever that the *Q. pannonica* of gardens is the *Q. conferta* of Kitaibel, a species which Endlicher referred to *Q. pubescens*, and Alphonse de Candolle to *Q. Farnetto* var. *β conferta*. For garden purposes it will be best to call the tree by its original name of *Q. conferta*. The tree is figured under this latter name in Reichenbach's "Ic. Floræ Germaniæ," xii., t. 646; and also in Kotschy's "Die Eichen Europ." (1862), t. 14. The latter figure is very good; in the former the leaves are more nearly sessile than is the case in the Edinburgh or native specimens.

It is a native of South-Eastern Europe, Transylvania, and Turkey in Europe, where it forms vast forests. Its wood is stated by Kotschy to be very durable, so much so that in certain Transylvanian mines, abandoned since the time of the Romans, and in which timber from this tree was used, the wood has still all the appearance of having been but recently felled. Further, we are told that the acorns are sweet to the taste, and are eaten by the Servians. In Hungary, we read, it is sometimes called the Black Oak, or the Gipsy tree, Kittu-jack.

It may be asked why I have adopted the name *conferta* instead of following either Endlicher or De Candolle, the former of whom, as we have seen, referred it to *Q. pubescens*, the latter to *Q. Farnetto* var. To this I reply that, in my opinion, formed after a comparison of numerous specimens in the herbaria, the Oak in question is distinct from either of the species to which it has been referred, though very possibly a derivative from one or other of them. The ordinary *Q. pubescens* of books and of plantations is quite different from our present plant, and nothing but confusion would arise from referring the latter to that species. I cannot think that it is any nearer to *Q. Farnetto*, to *Q. sessiliflora*, to *Q. pyrenaica*, or to any other of the species to which it has been supposed to belong. At the same time, I am too well aware of the impossibility of determining what is a species and what a variety among Oaks—or, indeed, among any other plants—to question the right of any one to come to a different conclusion from that to which I have

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arrived. I have preferred, for garden purposes, to treat it, as it really is, as a distinct form, to adopt for it the earliest specific name I could find—one under which the plant has been well figured and described, and one which, for garden use at any rate, is not inaccurate, is convenient, and will not lead to confusion. In ordinary parlance, perhaps, the appellation Hungarian Oak may be as convenient as any, though it must be remembered that the species is not confined to that country.

It may be convenient, lastly, to give the synonym of this species in brief as follows :—

Q. conferta, Kitaibel, in Schultes Œster. Flor. ii. ; Aufl. i. 619 (1814) ; Rochel, Plant. Banat. (1828), p. 26 (name only) ; Reichenbach, Ic. Flor. Germ. xii., tab. 646 ; Kotschy, Eichen Europ., t. 14 ; Wierzbicki, Flora (1842), pp. 269, 273, (good description); Schur, Enum. Pl. Transsilvan. (1866), 608 ; Koch, Dendrologie, ii. pt. 2, p. 41 (1873) ; Wilkomm, Forstl. Flora (1875), 347, where several other references are given.

Q. Farnetto, Tenore (1819), var. *β conferta*, Alph. D.C. Prodr. xvi. pt. 2, p. 11; Parlatore, Flor. Ital. iv. (1867), p. 184 (by error *congesta*).

Q. apennina, Lois. Desl. in Nouv. Duham. vii. 177, tab. 53 (1819), ex Koch, loc. supra cit. sed. vix.

Q. Esculus, Poll. Fl. Veron. iii. 125 (1824), nec L. ex Koch, l. c.

Q. pyrenaica var. (?), Loudon, Arboretum, iii. (1838), p. 1844.

Q. pubescens, Endlicher, Gen. Plant. suppl. iv., pt. 2 p. 24 (1847), vix Willd. Sp. iv., 450.

Q. pannonica, Hort. Booth, Edinb., &c.

Q. sessiliflora var. *pannonica*, Hort. Kew, Hemsley in "Gardeners' Chronicle," October 9, 1875, p. 455.

Q. hungarica, Hubeny, in Flora (1842), 269, et Hort. Germ., fide Koch, l. c.

Q. Pseudo-Ægilops, Arbor. Muscav. 624, ex. Koch. l. c.

Q. Ægilops-latifolia, hort. quorund, fide Koch, l. c.

Note.—Mr M'Nab laid on the table a branch of *Quercus conferta*, taken from a tree in the Royal Botanic Garden, 15 feet high and 23 feet in circumference of branches. This tree has not yet parted with a leaf, and presents at this time (January 13) a singular effect in the landscape.

Judging from the appearance of the stock on which it is grafted, the probability is that it has been worked on a Turkey oak. With the exception of some plants composing a beech hedge, where the branches are annually cut, and some young Turkey oaks, no other

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deciduous tree has leaves on just now. The *Quercus conferta* in question has never been subjected to cutting or pruning, notwithstanding the wood seems thoroughly ripened. The leaves in all likelihood will fall off immediately spring action commences. This individual tree has always been late of parting with its leaves, but never showed so many during previous winters as it does at the present time. Small plants frequently retain their leaves for a long time, but none had been known to retain them so long as the one here mentioned.

II. *On the Flowering of Spring Plants.* By Alexander Buchan, A.M., F.R.S.E.

During the past twenty years the Scottish Meteorological Society has been collecting data relative to the budding, leafing, flowering, and defoliation of trees and plants, and to the migration of birds in connection with the periodical return of the seasons, and it was proposed some time ago to discuss the material which has been accumulated. As preliminary, however, to this very difficult line of inquiry, it was resolved to discuss in the first place the observations which have been made by Mr M'Nab on the flowering of spring plants in the open air in the Edinburgh Royal Botanic Garden during the past twenty-six years, and which have been published in our Transactions. These observations have been made by the same observer on the same plants, growing in the same situations, during the whole of the twenty-six years.

The average day of flowering of thirty-two spring flowers has been determined, and are shown in the following table :—

Table of average date of Flowering of Thirty-two Spring Plants in Edinburgh Royal Botanic Garden.

Jan. 25. Galanthus nivalis.	Feb. 11. Sisyrinchium grandiflorum.
„ 30. Eranthis hyemalis.	„ 13. Crocus vernus and vars.
„ 31. Hepatica triloba.	„ 22. Daphne Mezereum.
Feb. 2. Corylus Avellana.	„ 24. Rhododendron Nobleanum.
„ 3. Rhododendron atrovirens.	„ 26. Nordmannia cordifolia.
„ 4. Crocus Susianus.	„ „ Symplocarpus fœtidus.
„ 8. Galanthus plicatus.	
„ 10. Leucojum vernum.	

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Mar. 7. Scilla bifolia (blue).
„ 10. Narcissus pumilus.
„ 11. Orobus vernus.
„ 14. Omphalodes verna.
„ 15. Scilla major.
„ „ Do. sibirica.
„ 17. Do. bifolia (white).
„ „ Scopolia carniolica.
„ 18. Muscari botryoides.
„ 19. Erythronium Dens canis.
Mar. 19. Draba aizoides
„ 20. Puschkinia scilloides.
„ 21. Scilla bifolia (red).
„ 22. Ribes sanguineum.
„ 28. Adonis vernalis.
„ 30. Narcissus moschatus.
„ 31. Do. Pseudo-Narcissus.
Apr. 1. Fritillaria imperialis.

The lateness or earliness of the different springs, as determined from the times of flowering of the thirty-two plants in each year, is considerable, as will be seen from the following table, in which the signs (—) indicates the number of days the season was late, and plus (+) the number of days it was early:—

Table showing the Deviation from the Average Dates of Flowering each year from 1850 *to* 1875.

Year.	Days early or late.	Year.	Days early or late.	Year.	Days early or late.
1850	— 1	1859	— 6	1868	+ 9
1851	+13	1860	+ 4	1869	+19
1852	0	1861	+ 7	1870	—16
1853	—14	1862	+ 8	1871	— 4
1854	— 2	1863	+ 9	1872	+10
1855	—30	1864	+ 1	1873	— 5
1856	—13	1865	—12	1874	+23
1857	—12	1866	+11	1875	— 3
1858	+11	1867	— 2		

Then the latest spring was 1855, which was thirty days later than the average, and the earliest 1874, which was twenty-three days earlier, thus giving a difference of fifty-three days between the latest and earliest springs during the past twenty-six years. As regards particular flowers, the deviations are much greater. The largest deviations from the average dates of flowering occur before the time of the equinox, when deviations of from five to seven weeks either way are of repeated occurrence; but after the equinox the deviations are markedly less, seldom reaching three weeks.

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The springs of 1855, 1856, 1857, 1865, and 1870 were late throughout; and, on the other hand, the springs of 1851, 1862, 1863, 1868, 1869, 1872, and 1874 were early throughout. Great variations have occurred in other springs, such as 1864, which, being preceded by a very mild December, many spring plants came into flower in the end of 1863. But in January the temperature was 2°·0 under the average, and in February, 5°·2, and vegetation was consequently arrested. March was also under the average, and the weather did not improve till April 3, the mean temperature of this month being 1°·7 above the average. The disturbing influence of this abnormal weather on the dates of flowering was in some cases very great. Thus, *Sisyrinchium grandiflorum* flowers on the average eleven days earlier than *Daphne Mezereum*, but in 1864 *Daphne Mezereum* did not come into flower till eighty-six days after *Sisyrinchium grandiflorum* had flowered. It is the occurrence of these disturbances which renders a long series of years necessary in order to arrive at a sufficiently close approximation to the true mean dates of flowering.

As regards Edinburgh, Jan. 11 may be considered as the turning point in the mean winter temperature, since previous to this date the temperature is, on the whole, falling, and after this date it continues steadily to rise.* Further, after this date, the rainfall becomes less, clear weather is of more frequent occurrence, and the increase in the temperature is very largely due to an increase of sunshine. The extremely slow rate at which, up to the end of February, the mean temperature rises, and the small differences among the temperatures up to this date, and the large number of plants—fourteen in all out of thirty-two—which come successively into flower during the interval, suggest that it is not so much absolute temperature that calls for consideration as the accumulated amounts of the preceding daily temperatures, *in the extent to which these rise above freezing*. The accumulated temperatures, thus calculated, are, for *Galanthus nivalis*, 72°·7, and *G. plicatus*, 146°·4; for *Crocus Susianus*, 125°·2, and *C. vernus*, 179°·1; for *Rhododendron atrovirens*, 120°·3, and *R. Nobleanum*, 249°.3;

* See Prof. Forbes's paper on the climate of Edinburgh, in Trans. Roy. Soc. Edin., vol. xxii. pp. 348–349.

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and for *Narcissus pumilus*, 347°·0, and *N. Pseudo-Narcissus*, 540°·1. Similar data prepared for other places, in this and other countries, would be very instructive in showing how far the order of dates of flowering in Edinburgh is observed in other places, and what is the relation of the dates of flowering at each place to the accumulated temperatures at that place, and what modifications are brought about by purely climatic differences, particularly as these occasion different results as respects the heating and actinic rays of the sun.

The thirty-two plants, whose dates of flowering have been determined, include three varieties of one species, viz., the *blue*, *white*, and *red* varieties of *Scilla bifolia*. Of these three varieties the *blue* flowers first, viz., on March 7; next comes the *white* variety, on March 17; and lastly, the *red* variety, on March 21, the *red* being thus a fortnight later than the *blue* variety.

An interesting question may in this connection be raised with reference to the relation which the colours of flowers have to the dates of flowering. With this view, our British wild plants have been grouped according to the different colours of their flowers and the months in which the flowers usually first expand, the data being taken from Dr Hooker's "Students' Flora of the British Islands." In classifying the plants, *red* includes pink, crimson, and scarlet; and *green*, all greenish-white, yellowish-green, and greenish-purple flowers. *Grasses*, *carices*, and other groups, characterised by inconspicuous floral envelopes, are excluded. The list examined includes 909 species, of which there are 257 with white flowers, 238 with yellow flowers, these two being nearly a half of the whole number; then follow red, 144; purple, 94; blue, 87; green, 51; and miscellaneous, 38. Taking each colour by itself, and calculating the percentages of that colour which has come into flower by each month from April to July, we obtain the following results for the first five classes:—

	April.	May.	June.	July.
Blue . .	16	43	71	93
White . .	14	36	70	97
Purple . .	4	28	61	92
Yellow . .	9	24	61	93
Red . .	9	25	62	94

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Thus, of these colours the *blues* are, on the average, considerably the earliest in flowering; then follow in order the *whites* and the *purples*, and lastly the *yellows* and *reds*. It follows that the plants included in the British flora clearly tend to arrange themselves, as regards the dates of flowering, in the order of the colours of the spectrum, the average earliest being those which are nearest the part of the spectrum where the actinic rays are at the maximum. It will be observed that the differently-coloured varieties of *Scilla bifolia* are in the same order of flowering of the plants of the same colours in the British flora. Accurate observations, continued from year to year, of the exact dates of flowering of different plants, and particularly of differently-coloured varieties of the same species, could not fail to contribute valuable data to the inquiry referring to the influence of the solar rays, in the development of the more important of the vital functions of plants in different seasons. Whilst it is quite true, as has recently been pointed out by Mr R. A. Prior in "Nature," vol. xii. p. 150, that flowers of all colours bloom in any of the spring or summer months, it is plain that it is only the method of inquiry by averages that can guide us in the search for the law or laws which regulate the seasonal distribution of colour among flowers. It is scarcely necessary to refer to the importance of this question in its possible applications in the rearing of early and late varieties of flowers and fruits.

III. *An Experiment with Turnip Seeds.* By A. Stephen Wilson, of North Kinmundy.

The seeds used in the following experiment were those of the Swedish Turnip (*Brassica campestris, rutabaga*), and were about two years old.

From a parcel were selected 100 of the largest seeds and 100 of the smallest. The 100 large seeds weighed 5·32 grains, or each seed weighed ·0532 of a grain, or 18·8 seeds weighed 1 grain. The 100 small seeds weighed 3·16 grains, or each seed weighed ·0316 of a grain, or 31·6 seeds weighed 1 grain. The large seeds stood thus to the small in the proportion of 1 to ·594.

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On October 27, at 12.30 P.M., the 100 large seeds were spread over wet cotton cloth on one side of a plate, and the 100 small were spread over the other side, and all were then covered with wet blotting-paper. The temperature of the room where they stood was usually about 53° Fahr.

On October 29, at 3 P.M., seven large and six small seeds began to show their roots; at 10 P.M. of the same day forty-two large and twenty-seven small seeds showed their roots. On October 30, at 10 A.M., sixty-nine large and sixty-five small, in various degrees, projected their roots; at 10 P.M. of the same day ninety-one large and eighty-six small had pushed out their roots. On October 31, at 9 A.M., ninety-five large and ninety-three small had pushed out their roots and various proportions of their cotyledons; at 10 P.M. ninety-six large and ninety-seven small showed their radicles, while two large had wholly thrown off the skin from their cotyledons. On November 1, at 10 A.M., ninety-seven large and ninety-eight small had burst their covering and thrown out their radicles; and on November 2, at 10 A.M., the whole 100 of large and small seeds had vegetated. At this time the longest roots or stems of the large seeds were about ·48 of an inch in length, and those of the small ·32 of an inch.

It is thus seen that the first seeds vegetated in about fifty hours, and that between the vegetation of the first and last seeds there was a period of about eighty hours, giving the most vital eighty hours of growth in advance of the least vital. The large seeds took the lead in vegetating, but the small overtook them at the end.

The plate was now set aside, and the plants duly supplied with water. The wet blotting paper was allowed to remain upon them till it was carried up by the growing stems and was then thrown off. The plants continued to grow, spreading out their cotyledonary leaves more or less for two months.

During the whole time there was a most marked difference between the group in the one side of the plate and the group in the other. The plants of the large seeds took the lead and maintained their superiority to the last. Both in height of stem and in thickness the plants of the large seeds preserved a conspicuous advantage.

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When some of the stems began to fall, and it appeared that little further growth was likely to take place, the two clusters were removed from the cloth on December 27 and laid aside to dry. The average height of the large plants above the cloth in the green state was 3·65 inches, and the average height of the small 2·87 inches.

Both sets of plants were dried on a sheet of paper beside each other. When about half dry they were weighed, and the large plants bore to the small the proportion of 1 to ·285. When completely dry the weight of the large was to the weight of the small as 1 to ·75. It was thus shown that the tissue of the large plants contained a greater proportion of evaporable matter than the tissue of the small, and that the tissue of the small was but three-fourths the weight of that of the large.

The lesson taught by this experiment seems to be that, other things being equal, a large Turnip seed will produce a larger Turnip than a small seed.

In looking at a drill of Turnips in any field, it is at once seen that scarcely any two plants in succession are of equal size. It can hardly be supposed that the soil and the amount of manure should vary in a distance of 9 inches; but since the size of the two bulbs differ, a possible cause of difference thus exists in the difference in original size of the seeds.

In a large seed the cotyledons are larger than in a small, and contain a larger store of *pabulum* for the young plants. But the young plant or embryo itself is larger in a large seed than in a small, and has been more liberally treated on the parent stock. The fleshy bulb of a Turnip is usually called the root, perhaps it might be more properly regarded as the stem, and it is seen by the present experiment that the stem, which is nourished by the cotyledons, is larger where the cotyledons are large than where they are small.

The writer proposes growing sets of Turnips to the full size, from large and small seeds, and will then be in a safer position to say whether it would be advantageous for seedsmen and farmers to sift out and throw away their small seeds or to sow them.

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10th *February* 1876.—Sir ROBERT CHRISTISON, Bart., President, in the Chair.

The following Communications were read :—

I. *Notice of Botanical Excursions made to different parts of Scotland in* 1875. By Professor BALFOUR.

Dr Balfour stated that although much had been done of late years in the examination of the Scottish flora, there still remained ground to be searched, even in localities the flora of which was thought to have been exhausted—such as Braemar, Clova, and the Breadalbane range of mountains. He then proceeded to give an account of the excursions made by the pupils of the botanical class and the Scottish Alpine Botanical Club, during which some interesting plants had been observed, the record of which he thought might be useful. On June 12, an excursion was made to Currie and the banks of the Water of Leith. The only thing worthy of remark was that the various species of introduced grasses and other plants (especially Cruciferæ) which were found in 1874 on the banks of the water near Mr Bruce's paper mills, had entirely disappeared, in consequence of having been covered up by rubbish thrown over the place. These plants had been imported chiefly from Spain, along with Esparto grass used in paper-making, to which reference is made in the present volume of *Transactions*, at p. 178. On June 19 a botanical party visited Balerno moor, wood, and reservoir, and the Black Hill, when they collected *Linnæa borealis*, *Rubus Chamæmorus*, *Pilularia globulifera*, *Littorella lacustris*, *Veronica scutellata*, and *Listera cordata*, &c. On June 26, a botanical trip was taken to the vicinity of Perth. The party visited the banks of the Tay, Kinnoull Hill, and the North Inch. Many plants of interest were found in the course of the excursion, including *Cerastium holosteoides*, *Erodium pilosum*, *Epilobium brachycarpum*, *Sedum album*, *Myosotis strigulosa*, *Allium carinatum*, *Ceterach officinarum*, *Parmelia perlata*. On July 3, a visit was made to Broughty Ferry, Forfarshire, where a party of between forty and fifty were kindly entertained

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by Mr G. B. Simpson, at Seafield House. Professor George Lawson, of Dalhousie College, Halifax, Nova Scotia, and Mr James Scrymgeour, from Dundee, joined the party. The ground examined was between Broughty Ferry and Barry, including the Links of Monifieth and the Links of Barry. Many rare plants were collected, amongst which were *Ranunculus hirsutus*, *Erysimum orientale*, *Teesdalia nudicaulis*, *Saxifraga tridactylites*, *Carex incurva*, *Elymus arenarius*, affected with the fungus *Uredo hypodytes*, and *Equisetum variegatum*. Mr Sadler gathered *Rosa subglobosa* and *R. dumalis*. On July 10 a party of between forty and fifty proceeded to Leslie, and thence walked to the Lothrie waterworks, where they were hospitably entertained by Provost Swan of Kirkcaldy. The party then visited the West Lomond Hill, and returned in the afternoon. The plants collected included *Radiola Millegrana* (on the shores of Loch Leven), *Sedum villosum*, *Gentiana Amarella*, *Veronica Anagallis*, *Listera cordata*, *Habenaria chlorantha*, *H. viridis* and *H. bifolia*, and *Hymenophyllum Wilsoni*. On Thursday, July 15, a party of thirty proceeded by train to Killin, and took up their quarters at Cameron's Bridge of Lochy Inn. In order to accommodate the party, a large hay-loft was put in requisition. On Friday, July 16, the party drove in conveyances to Lawers Inn, about 8 miles from Killin, and then ascended Ben Lawers, where were collected *Cystopteris montana*, *Cerastium compactum* (found by Mr Sadler), *Draba rupestris*, *Sagina nivalis*, *Saxifraga cernua*, *Erigeron alpinus*, *Myosotis alpestris*, and all the ordinary alpine plants. After an early breakfast on Saturday (17th), the party walked to the Cam-Chreag, or crooked rock, where many good plants were gathered, including *Gentiana nivalis*, *Sesleria cærulea*, *Woodsia hyperborea*, *Veronica saxatilis*, *Dryas octopetala*. Dr Isaac Bayley Balfour, Mr J. M'Millan, and Mr P. B. Gibb, who left the party the previous night at midnight to see the sun rise from the summit of Ben Lawers, again joined the party at Cam-Chreag. They had come along the top of the mountains from Ben Lawers, and on their way they collected some rare plants, amongst which were *Alsine rubella* and *Myosotis alpestris*, with pure white flowers.

On 24th July the Scottish Alpine Botanical Club pro-

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ceeded to Tyndrum, Perthshire, and took up their quarters in Anderson's excellent hotel there. On Monday, the 26th, they visited Ben Laoigh, a mountain 3708 feet high, one part of the mountain being in Argyllshire and the other in Perthshire. On the Perthshire side were gathered *Cystopteris montana*, *Bartsia alpina*, and *Arabis petræa*, all in great profusion. *Kobresia caricina* was also abundant in some places. Among the other plants of interest which were collected were *Draba rupestris*, *D. incana*, *Sibbaldia procumbens*, *Saxifraga nivalis*, *Vaccinium uliginosum*, *Salix Arbuscula*, *Carex vaginata*, *Poa Balfourii*, *Polypodium alpestre*, and *Lycopodium annotinum*. On Tuesday, the 27th, the party ascended Ben Doirrean, a mountain in Argyllshire, 3523 feet above the sea. It is of difficult ascent, and is not particularly rich in alpine plants. *Armeria maritima*, *Poa glauca*, *Thalictrum alpinum*, *Cherleria sedoides*, *Potentilla maculata*, and other species were collected. Some of the party visited Ben Chaisteil, a mountain near Ben Doirrean, the summit of which is 2897 feet above the sea. The principal plants met with were *Thalictrum majus*, *T. alpinum*, *Bartsia alpina*, and *Saxifraga nivalis*. On Wednesday, 28th, Ben Challum, in Perthshire, a mountain 3354 feet above the sea, was visited. It was found not to be a productive hill, the chief plants collected being *Bartsia alpina*, *Malaxis paludosa*, *Splachnum sphæricum*, *Œdopodium Griffithsii*, and *Tetraplodon mnioides*. On Thursday the party proceeded to Killin, and ascended Cam-Chreag, where the usual alpine plants known to grow there were collected, including *Gentiana nivalis* and *Myosotis alpestris*, with blue, purple, and white flowers. On Friday, 30th July, the party visited the grounds and ruins of Finlarig Castle. On several of the old trees of *Acer Pseudo-platanus*, the rare *Habrodon Notarisii* was found abundantly. This moss was first discovered by the late Mr M'Kinlay in 1865, on the old plane-tree which grows by the side of Killin parish church. In the afternoon the party separated.

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Thursday, 9th March 1876.—Dr Cleghorn, Vice-President, in the Chair.

The following paper was read:—

Observations on Mr Darwin's Views of Climbing Plants. By Thomas A. G. Balfour, M.D. Ed., F.R.C.P.E., F.R.S.E.

"The Movements and Habits of Climbing Plants." Such is the title of a volume from the pen of Mr Darwin which, as you are all aware, has recently issued from the press. It is a work of no ordinary merit, for, while we cannot but differ from this distinguished naturalist in his views regarding "the evolution of species," and fail to see the cogency of the illustrations of that doctrine which he adduces, we most willingly accord to him our high admiration of his skill and ability as a most accurate observer of nature. The very history, indeed, of the book before us affords us the best proof of the statement just made. In 1865 Darwin's observations on climbing plants were first recorded in the "Journal of the Linnean Society," and it was in this periodical that we read with intense pleasure the account of the numerous observations and experiments on that class of plants; and, though ten years have elapsed since that publication appeared, we do not observe that a single correction of any of the then recorded facts has been needed. Some additions have been made in the present volume, and the theory of the cause of twining movement in these plants has been somewhat modified in accordance with the views of Drs De Vries and Sachs; but his observations, which were then recorded as facts, are in almost every instance proved to be such. Nor is this anything else than what we should have expected if we consider, on the one hand, that the most minute particulars claim his attention, for nothing in nature is considered by Darwin to be beneath his observation; and, on the other hand, reflect on the mode in which he varies his experiments, and subjects his observations to the strictest scrutiny.

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To attempt a review of this interesting work is scarcely possible, as almost every page teems with facts for the establishment of which no one, who has not been engaged in similar investigations, can form any estimate of the amount of research required. We must, therefore, only give a short sketch of some of the most interesting passages, which may perhaps prove acceptable to those who have not yet procured for themselves this able treatise, and may not, I trust, be altogether unprofitable to others who have already perused it.

Among plants, as among men, we have two distinct classes determined by opposite characters: one, with widespread roots and strong erect trunks, is independent of others and entirely self-reliant; while the other class, destitute of that noble feeling of independence, cannot maintain its position without help; and we regret to add that the analogy extends farther, for the kind support thus supplied is too often ill requited, and, as the viper in the fable bit the man who had cherished it in his bosom, so the stem-climbers often strangle the trees around which they have twined. This is specially the case in tropical forests, and such climbers have no ordinary interest attached to them, even in an economical point of view, and have attracted the attention of Indian authorities, as their Blue Books testify.* In a practical as well as scientific aspect this class of the vegetable kingdom is thus seen to have claims on our regard. It is in its scientific bearings that Darwin treats his subject, and 206 pages are not more than sufficient for expatiating on the wonderful adaptations for their various functions with which these plants have been endowed by the beneficent Creator. At present I intend adopting the course of a climbing plant, and, by availing myself freely of the erect and strong stem which Darwin has formed, to attain my object at the expense of a small amount of tissue on my own part.

Darwin divides climbing plants into two great classes,— 1st, Those which twine spirally round a support, unaided

* In the working estimate of the Teak and Sál Forests, large sums are assigned for cutting *Bauhinia* and other destructive climbers, and in Mysore various species of *Convolvulus* are cleared away from the young Sandalwood trees.

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by any other movement; and 2d, Those which are endowed with irritable organs, which grasp the object which they touch, such as happens in the case of leaf-climbers and tendril-bearers. These are the chief divisions; but he has two subordinate ones, on which he touches only slightly, viz., the plants which ascend by means of hooks, and those which do so by rootlets, such as the ivy, &c.

No scientific generalisation can be strictly accurate, but merely approximately so, for Nature refuses to submit to such abrupt distinctions, and glories in the endless varieties which she continually presents to our view, and hence, though the above divisions are well suited for Darwin's purpose, yet even among the facts which he himself records we are supplied with illustrations of the inadequacy of the classification proposed; for we find that in a Bignonia and in the early stage of a species of Tropæolum we have examples of stem-climbing, leaf-climbing, and tendril-bearing plants; while in another species of Bignonia we have, besides these, ascent also by rootlets.

1. *Twining Plants.*—These are found in the three great divisions of the vegetable kingdom,—Dicotyledons, Monocotyledons, and Acotyledons. Thus the common Hop (*Humulus Lupulus*) and the common Honeysuckle (*Lonicera Periclymenum*) are examples of the first division; the Black Bryony (*Tamus communis*) of the second; and a Fern belonging to the Polypodium family (*Lygodium scandens*) of the third. Some twining plants move from right to left, while others take the opposite direction. So far as observation has gone, the greatest number of plants take the latter direction, *i.e.*, as Darwin puts it, opposed to the course of the sun; for in judging of the direction, he regards the plant as being in front of the individual, but we think it would have been better had he added when the back of the individual was towards the sun.* In regard to twining plants, there are three distinct movements which Darwin, and Dutrochet before him, have described: the first is a *revolving* movement, which is, "in fact, a continuous self-

* It is important that we should bear this in mind, for others regard the observer as being in the centre round which the plant twines, which would lead to the plant being described as climbing in the very opposite direction from that in which Darwin would describe it.

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bowing of the whole shoot, successively directed to all points of the compass, and has been well designated by Sachs as a revolving nutation." The design of this is evidently to enable the shoot to find a support. The second is the spiral twining of the shoot round the support; the spire thus formed is sometimes very close, and sometimes an open one; and, on some occasions, both of these features are exhibited by the same twiner. The third kind of movement is that of *torsion*, or twisting on its own axis. As this torsion does not occur when a stem twines round a smooth support, such as a glass rod, and as it manifests itself when rough sticks are used as the support, or when, in the case of glass rods, it has surmounted the summit and become free, Darwin thinks that the stem becomes more rigid by this axial twisting, just as a much twisted rope is stiffer than a slackly twisted one, and that thus it is enabled to get over inequalities in its spiral ascent, and to carry its own weight when at the top it revolves freely in the air.*

Let us now take the case of the Hop as Darwin has given it. When its shoot springs up, two or three of the first formed internodes are straight and do not move, the next formed, when young, exhibit the revolving nutation. In one instance, where he tied up the shoot and left only a young internode free, he found that this revolving movement seemed to increase in rapidity as it progressed—"*vires acquirit eundo;*"—24 hours were probably required for the first revolution, but the second was completed in 9 hours, the third in little more than 3 hours, and when it reached its maximum velocity only 2½ hours were required. At first the internode was not twisted on itself, but ultimately it became so; but while there were 37 revolving nutations, there were only three axial twistings. When a revolving shoot meets a support, "its motion is necessarily arrested

* Dutrochet believed that the twining movements were due to an expansion of one set of cells and a contraction of another set, and Darwin seems to think that this theory best accounts for the rapidity of movement displayed by sensitive tendrils on being touched; though in other instances he adopts the views of Dr De Vries and Prof. Sachs, who attribute the phenomena to increase of growth. As regards the torsion or axial twisting, Sachs believes that it results from "growth continuing in the outer layers after it has ceased, or begun to cease, in the inner layers."

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at the point of contact, but the free projecting part goes on revolving. As this continues, higher and higher parts are brought into contact with the support and are arrested, and so onwards to the extremity. . . . . As each internode loses from age its power of revolving, it likewise loses its power of spirally twining." So that, while there is no *necessary* connection between the axial twisting and the revolving nutation, this last is intimately connected with the spiral twining. The twining process, however, is performed more slowly than the revolving one, probably owing to the retardation by contact with the support; thus a Ceropegia performed its revolution in 6 hours, but required 9½ hours for its spiral twining once round a stick.

In speaking of Ceropegia (which is one of the Asclepiadaceæ, to which Natural Order several other twiners belong, *e.g.*, Hoya, Stephanotis, Dischidia), I may mention that Mr Lindsay and I studied the *Ceropegia repens* with considerable care, though the season of the year at which we did so was not favourable for observing all the phenomena; yet some of our observations were interesting, and as they illustrate some of the topics referred to by Darwin, I shall enumerate a few, which extended from November 26 to January 13. Darwin speaks of the spirals being drawn up, and on some occasions we noticed this, as we did also in *Stauntonia latifolia*, where we had good examples of the pushing or drawing upwards of the spirals to which Darwin refers—one being pushed up ¼ inch, another ½ inch, and some even 1 inch; the eighth circle seemed to have been pushed off the end of the stick, and stood about ½ inch above it. But our first observation on Ceropegia seemed to indicate that the spirals are sometimes pushed down; this seemed to be the case with two spirals which were apparently pushed downwards before, or while the third was forming, and when a fourth spiral had formed the third one was itself displaced downwards for ¼ inch, and in two days afterwards the second circle was pushed backwards for about ⅛ inch.

Another fact, to which Darwin also refers, was noticed by us, viz., that on the fourth day after the third spiral had formed it *un*twined itself, and stood stiff and erect at the side of the stalk. It must, however, have slipped down-

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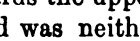
wards, as the mark placed on it was found to be on the same level *when it stood erect at the side of the stick*, as it had been when spirally twined round it.

Another point noticed was, that on the portion of shoot corresponding to the third circle, which was now standing erect, we found that the mark which had been on the convex surface previously was on the concave one, evidently in consequence of its revolution. A similar change was observed a few days afterwards at the part of the shoot which was at the top of the stick, the mark which had been on the outside of the shoot was now resting against the stick.

Another observation of some interest was this, that when the shoot surmounted the stick it formed two spirals. This took place in a different shoot from the last, and unfortunately we were unable to observe the subsequent course of the free internodes, as some green paint was used for marking which killed the end of the shoot. The shoot was not growing very well when the spirals were formed, which corroborates what Darwin, Palm, and Mohl have shown, that where free internodes of vigorously twining plants cease to revolve they become straight, and do not show any tendency to be spiral; and I suspect that Darwin's ingenious explanation must be applicable to my case, and that the lower parts of the terminal internodes were gradually and successively losing their power of movement, while the portions above were in like manner losing their power as they moved onwards, so that an irregular spiral would be formed.

In another instance we found that a spiral was formed on the free portion above the top of stick, which in a few days changed to a triangular form, and was turned vertically, and in five days afterwards the upper free shoot was merely curved thus  and was neither spiral nor triangular. In the case of another shoot which was growing very vigorously in spring, I found that after reaching the top of the stick it had grown quite straight for 1½ foot; at this point it caught another stick, and twined three times round it, then it circled another shoot from its own plant, then reached the branch of another plant round which it made two circles, and again became free and straight to its termination, which was 1¼ foot.

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One other point was noticed. I began to measure the internodes, and having put a red mark at the base of the first internode measured, which was at that time the penultimate one, it was found to be 2 inches long, and the second or ultimate internode was only about ¼ inch. On the 7th day afterwards the first internode was found to be 5 inches long, the second was 1 inch, while the third, which had been newly formed, was about ¼ inch.

On the tenth day after this the measurements were as follow:—first internode (which is now the fourth last one) is 5⅝ inch; second (which is now antepenultimate) is 4½ inches; third (which is now the penultimate) is about ⅛ inch; while the fourth (or new and ultimate one) is ¼ inch.

On the sixth day after last date the measurements were these:—first. 5⅝ inches, which is same as before; second, 4½ inches, which is also same as before; third (which is now the antepenultimate), which was ⅛ inch, is now 2⅝ inches; fourth (now penultimate), which was ¼ inch, is now ⅝ inch; fifth (newly formed or ultimate) is about ¼ inch.

On the eighth day after last date, the first, second, and third were the same as at last date; the fourth (now antepenultimate), which was ⅝ inch, is now 2¼ inches; the fifth (now penultimate), which was about ¼ inch, is now ½ inch; and the sixth (new or ultimate) is ¼ inch.

Measurements of Growth of Internodes of Ceropegia repens, *beginning with Penultimate and Ultimate, and including the others as they arose.*

		Dec. 13.	Dec. 20.	Dec. 30.	Jan. 5.	Jan. 13.
		inches.	inches.	inches.	inches.	inches.
At first.	Penultimate, 1st,	2	5	5⅝	5⅝	5⅝
	Ultimate, 2d,	¼	1	4½	4½	4½
	3d,	...	¼	⅛	2⅝	2⅝
	4th,	...	...	¼	⅝	2¼
	5th,	...	...	...	¼	½
At last.	Ultimate, 6th,	...	...	...	...	¼

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It will thus be seen that the growth is mainly confined to the internodes which are penultimate and ultimate at the different periods. This seems to correspond to Darwin's results, for he speaks of the *growth* of the penultimate internode as being the cause of the pushing up of the spire formed on a stick by the terminal internode (p. 18).

Another point which interested us much was the following. When a shoot of Ceropegia came into contact with a long slender stick, it took long sweeps up the stick before completing the spire, but after having taken one or two such, it was generally approaching the top of the support, and immediately the subsequent two or three spires formed were very near each other; when a fresh stick was fastened to the first one, so as to increase its height considerably, the first formed spiral or spirals were much elongated, but became shorter when the end of the stick was approached; a third stick was added to the end of the second one, and a similar course was pursued by the shoot. It reminded us much of the doings of some young man who had come into possession of a fortune, and who, thinking that it could never be exhausted, most lavishly expended vast sums of money, but at length finding his resources beginning to fail, immediately commenced retrenching, and kept his expenses within his annual income. This peculiarity was noticed in more than one shoot of *Ceropegia repens*—evidently with the design of getting quickly to the light, and yet of holding firmly to supports.

We have already spoken of plants twining in the direction of the course of the sun or against it; and while species of the same genus almost always climb in the same direction, yet we have some exceptions; thus, *Mikania scandens* moves from left to right, but another species climbs from right to left. In *Solanum Dulcamara* (Bittersweet) we find that both directions are sometimes taken by the same stem, as Dutrochet had pointed out. Among several plants of *Loasa aurantiaca* some twined in one direction and some in the opposite, while others adopted one course at first and afterwards reversed it, as happened also in *Loasa Herbertii*. Another interesting point is the thickness of the supports of twining plants. Darwin remarks that while tropical twiners and those in

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the warmer temperate regions can ascend thick trees, and instances Fritz Müller, who has seen in the forests of South Brazil one of the Menispermaceæ surrounding with its spiral a trunk which was about 5 feet *in circumference*, yet in our temperate climate Darwin has only seen one instance of twining round a tree, and that was in the case of a honeysuckle, which encircled a beech tree 4½ inches in diameter. A *Phaseolus multiflorus* in the open air could twine round a support of 3 or 4 inches in diameter, but failed in doing so when the diameter was 9 inches; and as the final cause of this arrangement he adds, "This power would evidently be almost necessary for twining plants inhabiting tropical forests, as otherwise they would hardly ever reach the light. In our temperate countries twining plants which die down every year to the root would suffer if they were enabled to twine round trunks of trees, for they could not grow tall and gain the light." As illustrating these remarks, I may mention the *Bauhinia Vahlii*, which twines around and overtops the highest trees in the forests of India, and which attains the length of fully 300 feet.

Light has a powerful effect on the rapidity with which revolutions are executed. On this subject our author gives us a most instructive example in *Ipomœa jucunda*, which made a complete revolution in 5 hours and 30 minutes; now, in accomplishing this circle, the semicircle *from* the light took 4 hours and 30 minutes, while that *towards* the light occupied only 1 hour. Temperature also, as might have been expected, influences the rate of revolution.

Some twining plants exhibit striking peculiarities: the *Combretum argenteum* Darwin found to have two kinds of shoots; most of the shoots did not exhibit any revolving propensities, but one of them revolved and turned most vigorously. The same is true of *C. purpureum*, which for months has looked quite shrubby, but within a few days has sent out several twining shoots with little developed leaves, which have most vigorously twined around sticks. Leon had before shown that certain varieties of *Phaseolus multiflorus* give out some shoots which are thick and upright, and others which are thin and twining. In *Polygonum convolvulus* the season of the year seems to determine this twining property, which is only

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manifested during the middle of summer; for, though it may grow vigorously in autumn, it exhibits no tendency to twine. Again the main stem of *Tamus elephantipes* does not twine, the branches alone do so. A species of Ipomœa in South Africa is almost always firm and erect, attaining the height of 1 or 1½ foot, while seedlings of this plant raised near Dublin twined up sticks 8 feet in height.

2. The second class has two subdivisions, viz., leaf-climbers and tendril-bearers. The leaf-climbers accomplish their object either by means of the petioles or of the prolonged midrib. Several observations are recorded very fully on eight species of Clematis and on seven of Tropæolum, besides others on Maurandia, Solanum, Fumaria, Gloriosa, Nepenthes, &c. These investigations have been prosecuted with great care and skill, and reflect the highest credit on the patience and ability of the observer. He has shown that if the petioles of Clematis are left to themselves they do not twist or bend, and hence when we find old petioles so affected we may be sure that, in their young state, they must have come into contact with some object which has subsequently been removed, and we may be also certain that that removal must *not* have been effected *immediately* after the contact, else the petioles would have again assumed their straight condition. The clasping tendency of the petioles is owing to their sensitiveness or irritability, which is found presenting peculiarities in degree and situation in different species; thus in *Clematis glandulosa* it is found on both sides of the petiole, but it exists in a greater degree on the under surface. In *Clematis montana*, again, the petioles are much more sensitive than in the last species; the main petiole has the sensitiveness extending along its whole length, but this property is not communicated to the three leaflets which it carries. In *Clematis Sieboldi* the petioles of the lateral and terminal leaflets are also sensitive; while in *Clematis calycina* a curious compensating property is displayed, for the main petioles are highly sensitive in their young state, and lose this property when they are old; while, on the other hand, the three divided leaflets have scarcely distinct petioles, and no sensitiveness connected with them, while the main petioles are strongly so; but no sooner has the main petiole ceased

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to be sensitive than the petioles of the lateral and terminal leaflets elongate, and acquire the property which the main petiole has lost. Such are a few of the interesting observations recorded. The amount of sensitiveness in these cases was determined by minute portions of thread of different weights—some of them only $\frac{1}{16}$th of a grain—being brought into contact with the petiole, and observing the amount of weight to which the bending response was given, and also the time in which that was accomplished. In many of the species, however, the stem also performed feats of climbing, though in some instances, when the petiole had clasped a support, the stem remained erect, presenting the appearance, as Darwin has well expressed it, of a man standing beside a stick with his whole arm thrown around it. I have, however, seen both petioles firmly grasping a stick; and in another portion of the same plant I have witnessed one petiole twined twice round a neighbouring stem of the same plant, while the other petiole was twisted twice round its own stem.

When a petiole has entwined itself around an object, it sometimes becomes much thickened and strengthened, a swelling occurs in the course of two or three days, and ultimately the petiole grows nearly twice as thick as the opposite leaf-stalk which has clasped nothing; and while this latter remains quite flexible and is easily broken, the clasping petiole becomes remarkably tough and rigid, which, of course, has the effect of enabling the petiole to support the stem in a strong and durable manner. This change is seen notably in *C. glandulosa* and *C. calycina*. In *C. montana*, so far as I have observed, the increase of bulk was not apparent, but the firmness and toughness were decidedly so. A rapid and considerable enlargement is acquired by the young petioles of *Lophospermum scandens* (a Mexican plant of the order Scrophulariaceæ), when these have encircled an object. Perhaps the most interesting illustration of this change is given by Darwin under *Solanum jasminoides*, of which change he has supplied two most instructive figures. Of the plant itself he says, "In this plant, and in no other leaf-climber seen by me, a leaf *grown to its full size* was capable of clasping a stick; but the movement was so extraordinarily slow that in the

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greenhouse the act required several weeks." And regarding the increase of size and internal changes of the clasping petiole, he thus writes: "When the flexible petiole of a half or a quarter grown leaf has clasped any object, in three or four days it increases much in thickness, and after several weeks becomes wonderfully hard and rigid, so that I could hardly remove one from its support;" and on comparing a transverse section of this petiole with that of one which had clasped nothing, he found its diameter fully doubled and its structure greatly changed, there being, besides other variations from its normal condition, a large development of woody tissue with lines radiating from the centre. After similar careful observations on seven species of Tropæolum, where phenomena not unlike those previously recorded were noticed, Darwin concludes with the remarks: "We have seen in this genus a gradation from species such as *Tropæolum tricolorum*, which have exquisitely sensitive petioles and internodes, which have rapidly revolving powers, and can spirally twine up a support, to other species, such as *Tropæolum elegans* and *Tropæolum tuberosum*, the petioles of which are much less sensitive, and the internodes of which have very feeble revolving powers, and cannot spirally twine round a support; and lastly to *Tropæolum minus* (the dwarf crimson Nasturtium), which has entirely lost or never acquired" (or rather, been endowed with) "these faculties."

Besides the leaves which twine by means of their petioles, we have those which ascend by the prolonged midrib. A good example of this process is supplied by the highly ornamental genus Gloriosa—a species of which, *G. Plantii*, Darwin minutely describes; but we shall here simply allude to one or two points in connection with the growth of this plant which beautifully illustrate a principle of the divin government. The first is the strict economy which is displayed by the Author of nature amid the lavish profusion with which he has surrounded us, for while the plant was only six inches high and could support itself, its climbing powers were not developed, the tips of its leaves were not sensitive, and the stem did not revolve; and, aga n, when it had reached its maximum growth the leaves at the summit were destitute of s nsitiveness and could not clasp

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any object. Another illustration of this same principle is afforded us by the withdrawal of a property, once possessed, when the plant has failed to make use of it aright, and when it can no longer be of any avail; thus when a leaf has caught hold of nothing, and has curled inwards so as to form a ring, its sensibility is lost. From this last illustration who can fail to be reminded that in the moral government a like principle is in operation, as the solemn announcement so clearly proves, "He that hath not, from him shall be taken even that which he seemeth to have."

Under this division our attention is directed to the genus Nepenthes or true pitcher plants. At one time the jointed lid of the pitcher was regarded as the modified lamina or blade of the leaf, and all the structures between it and the stem as a phyllode or modified petiole; but the real nature of the structure has been pointed out by Dr Hooker, who shows that the apparent leaf springing from the stem is the true lamina, and that the tendril-like appendage is the prolonged midrib, which, becoming folded on itself at the end, forms the pitcher, which latter organ he regards as the analogue of a secreting gland situated at the end of the midrib in certain plants, such as *Richardia africana.*

In the Nepenthes the climbing or clasping is effected by the prolonged midrib between the lamina and the pitcher, which, when it surrounds a support, becomes thickened and hardened, of which any one can easily convince himself by pressing on the coiled and uncoiled portions. This coiling, however, may be sometimes witnessed in cases where no support has been grasped, and occurs in some midribs which fail to produce pitchers at their ends. Darwin believes that "the chief use of the coiling, at least while the plant is young, is to support the pitcher with its load of fluid," which, in some instances, has no small weight.

We now come to the second division of the second class, which includes tendril-bearers, and which is perhaps the most interesting part of the whole book. True tendrils, homologically considered, are modifications of leaves, flower-peduncles, branches, and perhaps stipules. The Bignonias supply us with examples of the first modification, as their tendrils are *altered leaves;* the tendrils of the *Vitis vinifera* are modified *flower-peduncles;* the Strychnos has its

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branches transformed into true tendrils, and if we regard the tendrils as representatives of arms, we have in this last case a happy reversal of the sad fate of Daphne, of whom the poet so plaintively sung, "*In ramos brachia crescunt.*" In the case of *Smilax aspera* Mohl regards the tendrils which arise from the petiole as *modified stipules.*

The Bignoniads are the trumpet-flower family, and in some instances these organs are large, numerous, and beautiful, and, as Lindley has said, "are the glory of the places which the species inhabit;" but, with the humility which is ever characteristic of true merit, the plants rather shun than court publicity, for in dark corners rather than in the blaze of light they quietly and unobtrusively perform their appointed duties; they never blow their own *trumpets*, but leave that duty to be discharged by others, and this has been done so effectively by Mr Darwin, that henceforth most of the members of the family will deservedly command the admiring attention and regard of the civilised world. Darwin treats of nine species of Bignonia, and to some of these we must refer.

Bignonia unguis has an imperfectly twining stem. Each leaf consists of a petiole bearing a pair of leaflets and ending in a tendril which, like the leg (or rather, tarsus) of a bird, divides into three toes of equal length and in the same plane, and which terminate in sharp, hard claws. The petiole and tendril with its three toes are sensitive; and when the toes have clasped a twig, an appearance like that of the perching of a bird is presented, the *posterior* toe being, of course, absent. Darwin regards this plant as one of the most efficient climbers. I have on several occasions watched with much interest the mode of ascent of a species of M'Fadyena, one of the Bignoniaceæ, which bears the closest resemblance to *Bignonia unguis*, and I can certify as to the accuracy of Darwin's description of that species. The M'Fadyena presented a most pleasing object with its three toes firmly grasping with their claws the bricks of the walls of a greenhouse, with the two outspread leaflets immediately behind them; the firmness of the hold was very considerable, and my fingers can testify to the sharpness of the terminal claws, and to their admirable adaptation to lay hold of any object which may come

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in their way. In one instance where a stick had been placed beside a M'Fadyena, the twining power of the stem did not seem very efficient, for the circles, two in number, were wide and could easily have been withdrawn from their place, but near the top of the stick the tarsus and three toes had embraced it firmly, and gave a fixity to the plant which it could not otherwise have obtained. Even when the leaflets are in a young state the efficiency of the claws is perfect. In this genus I found some aërial rootlets proceeding from below the attachment of the petioles. But to return to *Bignonia unguis*, it, as we have just seen, and *Bignonia Tweediana*, a species introduced from Buenos Ayres in 1838, possess the power of stem-climbing to a greater or less degree, and by means of the revolving movement of the stem the tendrils are brought into contact with sticks or twigs, and as the petiole and tendril (consisting of the tarsus and toes) are all sensitive the object is firmly clasped, while in *B. Tweediana*, as if to "make assurance doubly sure and take a bond of fate," aërial roots are emitted from the basis of its leaves, and curve partly round and adhere to the twig or stick. When a tendril has clasped an object it ultimately becomes strengthened—a condition which, as we have seen, occurs in other instances; but if it should fail in attaining this end, it seems ashamed of itself and bends slowly downwards, and its power of clasping is lost, and as if disgusted with its inability now to render any further service to the plant, it in a short time afterwards disarticulates itself from the petiole, and drops like an autumnal leaf. This process is peculiar, as in the case of other tendrils under similar circumstances they merely wither away.

Another species, the *Bignonia venusta*, I have had many opportunities of studying. The petiole, $\frac{5}{8}$ inch, the tarsus, which here is much longer (being on an average about $3\frac{3}{4}$ inches), and the three toes ($\frac{3}{4}$ inch each) lie in different planes. A similar appearance of ternate division at end of tendril occurs also in *B. littoralis*, *B. chevére*, a native of French Guiana (whose toes also end in suckers), and in *B. Chamberlaynii*, which is a variety of *B. æquinoctialis*, and was introduced from Brazil in 1820. In speaking of Brazil, it is interesting to know that in some of the forests of that

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country the Bignonias are so numerous, and by their flexible stems and tendrils so pass from tree to tree, as to render these forests almost impassable.

An appearance exactly similar occurs in an unnamed plant in the stove of the Edinburgh Botanic Garden, where the tendril is one of the three branches into which the petiole divides, and is sometimes five inches in length, the three toes being each about $\frac{5}{8}$ inch long. In this plant there is an interesting illustration of the manner in which leaves may be modified, but on this point I cannot at present dwell. Darwin declares that, though the tendrils of *B. venusta* can make considerable sweeps, yet even they are aided by the revolving power of the young internodes, and if the stick which has been ascended is thin, the right and left hand tendrils are alternately used. In *B. littoralis*, on the other hand, which is not a stem-climber, both tendrils seize the stick at the same part and at once. In connection with *B. venusta* both Mr Lindsay and I noticed that when a young shoot was given off no tendril was formed till the end of the fourth internode, a *third* leaf supplying the place of that organ at all the previous internodes, thus affording another instance of economy in nature, for when the shoot was able to support itself no tendril appeared. Axial twisting is distinctly seen in some of the internodes. Darwin states that when a tendril has caught nothing it does not contract spirally; here, however, there is apparently some mistake, for I have seen on more than one occasion the spiral twisting where the tendril was quite free. I shall give one instance: a tendril which was given off from the lower portion of the end of the petiole (probably owing to the leaves having risen up towards the light) was seen pointing downwards, and from its termination the three toes were projecting out at right angles to it, and though nothing had been caught, there were on the tarsus two spirals, each consisting of two circles, the first one being situated at $\frac{1}{2}$ inch from the beginning of the tarsus, and the second being $\frac{1}{2}$ inch from the first. Another case that interested me was this: a tendril (or rather the *tarsal* portion of it) had encircled by its distal extremity an adjoining stem, and other eight fine spirals had formed above this, extending to $\frac{1}{2}$ inch of commencement of tarsus; the toes were grasping nothing; one

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of them was in a kind of elliptical form, another formed a semicircle growing gradually thicker towards the point, while the third toe had two beautiful spirals formed on it.

Darwin attributes no power of producing suckers to this species, and on looking at the tendrils which were on the stick in front and facing the light, we could discover no trace of suckers, but, on turning round the portion of plant which was nearest to the wall, we found, on what had been the darkest portion of the stick, three tendrils, from a vigorously growing part, which were grasping a green painted stick (not very rough) by their three toes, and in each case two of the toes were terminated by fine round white suckers. A fourth tendril had a sucker on only one of its toes. All the suckers were at the back except one which was at the side of the stick. Mr Darwin at one time believed that suckers were not formed until the point of the tendril had attached itself to an object. Dr M'Nab, however, pointed out that the tendrils of *Ampelopsis Veitchii* bore small globular discs before they had come into contact with any object; and Fritz Müller showed that the trifid tendrils of *Haplolophium*, one of the Bignoniaceæ, did, without contact with an object, end in smooth shining discs. In his recent work Darwin assents to the accuracy of both these observations, though he believes that the discs considerably enlarge when they adhere to some object, and it gives me much pleasure to say that the above statement expresses my experience in the case of *B. venusta*, for, on examining the suckers referred to, only one was found firmly attached to the stick (though more afterwards became so), the others were easily moved by a slight touch, and some of these had the side of the sucker lying against the stick; but those which were *attached* were the most developed. Cotton wool and sphagnum were fastened to the stick, but on the second day afterwards there was no indication of any of the tendrils touching it.

Bignonia speciosa next claims our attention. Here also we find the same principle of economy illustrated by the non-development of tendrils when the plant is young and has no need of a support. Even after the tendrils have appeared, they, in their early stage, exhibit a fickleness and capriciousness somewhat akin to that which is not uncom-

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monly displayed at comparatively early periods by our own race. They are impatient of restraint, unsettled in their habits, and seem bent on proving that they have a will of their own, and hence we find them sometimes refusing to clasp a stick, or, after having grasped it, loosening their hold and relinquishing their task. With maturer years, however, a greater steadiness of purpose seems to be developed. The tendrils in this species, and also in *B. picta* and *B. æquinoctialis*, which is a shrubby plant, end in a sharp and nearly straight point, which exhibits a strange peculiarity in searching out holes into which it may insinuate itself, and when such a crevice has been found the point bends at a right angle in order to enter it, and may even bend again to gratify its desire to explore some other hole which may open into the crevice; and though, by its frequent withdrawal of itself from these holes and inserting itself into others, a slight reappearance of its early unsteadiness might by some be suspected, yet it is not really so, for it seems to be anxiously engaged in seeking a proper field for the display of some potential energy which it possesses, as the analogy in the case of *Bignonia capreolata* apparently indicates.

This *Bignonia capreolata* is perhaps the most interesting and instructive of all the tendril-bearers. The tendrils here are much branched, there being five, or, as I have observed, even seven branches, each of which is bifid or trifid at the point, which ends in a blunt hook. These tendrils seem to be sensitive on all sides, and, unlike leaves, of which they appear to be modifications, they move *from* the light. This tendency was proved by Darwin by various experiments of a most conclusive kind. Now these tendrils, like those of *Bignonia speciosa* and *B. picta*, exhibited a like capriciousness in seizing and abandoning a stick for even three or four times; yet when a fissured post was placed near the plant a very different course was pursued by the tendrils, for their points and the tips of even miniature tendrils crept in a surprising and beautiful manner into the various crevices, and after two or three days, the development of balls by the swelling of the tips and inner surfaces of the hooks commenced. But, as another experiment of Darwin's imitated the natural condition of the plant still more accurately, I shall under it enlarge on the

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formation and functions of these disc-like, or rather, globular bodies. Flax, moss, and wool were bound loosely round sticks, which resembled much the lichens, mosses, &c., which clothe forest trees, and also the *Polypodium incanum*, which, as Prof. Asa Gray declared, was abundant on those trees in the districts of North America in which this species of Bignonia abounds. Having placed the stick, thus prepared, near a tendril, the hooked points seized and penetrated the fibrous mass. The tips now began to swell, and in a few days "the hooks were changed into whitish irregular balls rather above $\frac{1}{20}$ of an inch in diameter, formed of coarse cellular tissue." The balls by their surface secreted a viscid resinous matter, which is soluble in ether, and which causes the fibres to adhere so that fifty or sixty fibres may be seen crossing a little ball at various angles. Sometimes eight discs are formed on the same tendril. After the discs are developed, spiral contraction of the tendrils occurs, and they become woody and strong. An analogous cellular layer, which secretes a resinous cement, was found by Darwin to be formed by the lower surface of the branches of the tendril of *Hanburya mexicana*, one of the Cucurbitaceæ, after it had, for a few days, grasped a stick. In the Ampelopsis, as is well known, a similar appearance is presented, and to that I shall presently refer.

In a fine specimen of *B. capreolata* which I had an opportunity of studying, I found the main petiole about half an inch long, and the sub-petioles of the two leaflets about one-quarter inch. The tarsus or tendril was evidently the terminal portion of petiole, though it bent down at an angle from the end of the leaf stalk. It ultimately divided into five and sometimes even seven branchlets or sub-tendrils, formed respectively by two or three pairs of representative leaflets with a terminal odd one, and three sub-tendrils ended in a bifid or trifid manner. Thus, on examining a tendril, five of these sub-tendrils were found all twined together, and on carefully separating them, the first pair were trifid at the extremity, the next pair had one bifid, and the other ending in a single point, and the odd or terminal sub-tendril was bifid.

On some portions of the front sticks a few suckers were found, but on the part of the stick at the back which was

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facing the wall the suckers were numerous, and very firmly attached to it, which was an unpainted one, by no means very rough, and which had no fissures. On a stick at the front where there was a growing shoot with tendrils, but no suckers, a flower-pot was inverted. On taking off the pot on the second day the shoot had grown about 1½ inch, and the tendrils corresponding to the second last internode had, in some instances, at the bifurcations of the sub-tendrils, small sucker-like bodies formed, which became more distinct and numerous in a few days afterwards. I should have mentioned that the pot was replaced.

The suckers in some cases were attached firmly to the stem of the plant, and even to the edge of a leaf. Here, as in *B. venusta*, many discs were formed where no object whatever had been grasped, though in these instances the suckers seemed smaller than when an attachment had been effected.

We reluctantly pass over *Eccremocarpus scaber*, a native of Chili, belonging to the Bignoniaceæ, *Cobœa scandens*, one of the Polemoniaceæ, and some belonging to the Leguminosæ, and shall only touch on the Smilaceæ. The *Smilax aspera* var. *maculata* is well figured and described by Darwin. The tendrils in this case spring in pairs from the petiole, and are by some, as already mentioned, regarded as modified stipules, while others consider them to be changed petioles. It seems a difficult point to determine which party is right. After a careful examination of a dwarfed specimen of *Smilax aspera*, I was led to conclude that the minute tendrils were really petioles; but in the *Smilax officinalis* they seemed to be modified stipules, for the base of the petioles seemed thickened by what appeared to be a sheathing stipule, from the end of which the tendrils seemed to spring, or rather to be a continuation; this took place about half-way between the stem and the attachment of the leaf to the petiole. The tendrils of *Smilax aspera* are, according to Darwin, from 1½ to 1¾ inch long. They are sensitive when rubbed on either side. They at first stand erect, but when old bend backwards and downwards, still, however, retaining their sensitiveness, and do not contract spirally in any case. Its stem is well supplied with spines, hence its specific name.

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In contrast to this we have studied a fine specimen of *Smilax officinalis*, whose enormous leaves measured from the jutting backwards from attachment of petiole to the point of leaf 11 inches, and whose greatest breadth was 6 inches. One tendril was 7¾ inches in length, and another was actually 9 inches. The stem and shoots were square, and exhibited twisting on themselves. The spines, which are mostly curved as hooks (but which in some cases are straight), are frequently given off in pairs, but also singly. In three instances the spines between several of the internodes were counted, and it was always found that the first and second internodes were destitute of spines, while on the other the spines varied from 2 to 12, and even 14. For example, a stem had spines on the internodes as follow: —1st, none; 2d, no spines; 3d, 2 spines; 4th, 12; 5th, 14; 6th, 6; 7th, 7; 8th, 7; 9th, 9; 10th, 9 spines. No more were counted, but there were 21 internodes on this stem.

On the internodes of a young shoot the spines were— 1st internode, no spines; 2d, no spines; 3d, 2 spines; 4th, 5; 5th, 7; 6th, 10; 7th, 6; 8th, 8; 9th, the spines had not broken through the epidermal covering, but the elevations pointed to their being 6 at least; 10th, which was the last internode formed as yet, was quite smooth, no spines having yet formed. On the internodes of an older shoot—1st, none; 2d, no spines; 3d, 1 spine. The tendrils of this species were seen distinctly spirally contracted when an object was caught.

On the Cucurbitaceæ, though deeply interesting as a whole, and specially so in the case of the North American annual *Echinocystis lobata*, and in that of the Mexican genus—whose name painfully reminds us of the loss we have sustained by the death of a distinguished pharmacologist—*Hanburya mexicana*, on these, I say, time forbids me to dwell, though Darwin's description of them will well repay a careful perusal. Under the Vitaceæ I shall omit all reference to the vine, and shall confine my few remarks to Cissus and Ampelopsis. In *Cissus discolor* the tendrils are formed of a long footstalk, bifurcating at the end, but the branches so formed are generally of unequal length. This disparity in length is much greater in *Cissus albo-nitens*. The long footstalk is sensitive, but not nearly to the extent that the

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branches are, for the slightest touch is sufficient to cause these latter to curve; but these are equally sensitive on both sides, so that if they are drawn between the fingers no movement ensues—an important point to bear in mind, as Darwin ingenuously informs us that it once misled him. In one instance we found that a slight touch was followed in about two or three minutes by a distinct bending of the long footstalk, and after curving downwards towards a stick, it gradually moved round about 90°; this movement occupied about one hour; in about one hour and a half the tendril had become quite straight, and was back again to its old position. In about five minutes after being touched on its inner side, the smallest fork was curved slightly inwards. On the following day the footstalk of the tendril had caught the stick, and was closely applied to it for about half of its circumference, while the remaining half of the circle was completed by the branches or forks. The stick was $2\frac{1}{2}$ inches from the stem from which the tendril sprung; but in two days after this occurrence, three fine spirals were seen at the portion of the footstalk close to the stick, and now the contraction caused by this spiral movement brought the stem within $1\frac{3}{4}$ inches of the stick. On the second day after this three other spirals, but more open than the former, were formed; and on the day following another spiral was added. These spiral contractions which occur in tendrils which have caught a support seem designed to accomplish a twofold object—1st, to draw the shoot nearer the support, and thus facilitate the grasping of it by the subsequently developed tendril; and 2d, to diminish the strain to which a tendril without such an arrangement would be subject. Before performing its revolution in quest of a support, the *tendril* rises up, while the end of the *shoot* bends downwards so as not to arrest its progress.

Under *Ampelopsis hederacea* both the description and figures are admirable. Often have we studied the allied species *A. tricuspidata* and *A. Veitchii*, whose sucker-like pointed tendrils when fixed against a wall, especially when the branches of these are spirally contracted, present a most pleasing object. The closeness with which the stems are held to the wall, and the strong resistance which they offer to any attempt to remove them, show how admirably

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adapted the provisions are for accomplishing the end in view. The discs consist of enlarged cells, with smooth projecting hemispherical surfaces, coloured red, and at first gorged with fluid, but ultimately becoming woody. By the solvent employed Darwin proved that the substance secreted was of a resinous nature, which would aid the cellular outgrowth (which insinuates itself into every crevice) in securely fixing the plant to its support. In proof of the tenacity of the branchlets of the tendrils, Darwin mentions that an old one was able to support a weight of 2 lbs., and he reckons that the whole tendril would, at the same rate, have resisted a strain of 10 lbs. I suspect, however, that the age in this case must have contributed largely to the result, for on selecting the terminal portion of a branch of *Ampelopsis tricuspidata* (which, however, had at that time been growing on a wall for only two months), which was fixed firmly by three tendrils, and attaching a weight of 4 lbs. to the lowest of the tendrils, the portion of the branch and its tendrils were pulled from the wall; and on examination it was found that the tendril nearest the end of the branch had one of its seven discs pulled away, while the other six were left adhering to the wall; the next tendril had left its six discs sticking to the stone; while the remaining one, which was attached entirely to lime, had six discs pulled off, and one left on the lime. If we could draw a conclusion from this observation, it would be that the discs, when attached to an unyielding surface, are quite able at an early period to resist a heavy pull, but that the other portions of the structure of the tendril require a much longer time for attaining that woody firmness and toughness which, in the case of Darwin's species, exhibited such remarkable tenacity. About five months afterwards four or five additional experiments were made on the same plant, which fully bore out our previous conclusion.

Experiment 1.—A portion of stem was chosen which was fixed by two tendrils, the tendril above having eight suckers, and that below having seven, all attached to stone. At 4 lbs. the centre of the stem broke across, while the tendrils and suckers remained intact.

Experiment 2.—A stronger stem was chosen with a tendril above bearing seven suckers, and one below with

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five. With 4 lbs. of traction the lower tendril gave way at its attachment to the stem, but neither the branches nor the suckers yielded.

Experiment 3.—A stem chosen even thicker than the last, the upper tendril having nine suckers, and the lower one eight. In this case a traction equal to 6 lbs. was required before the tendrils gave way at the attachment to stem; the branches and suckers were uninjured.

Experiment 4.—Another tendril with eight suckers was itself subjected to direct traction, and at 4 lbs. two branches broke across just at their commencement, but the suckers did not yield. On trying still further with 4 lbs. weight, another gave way in a similar manner, the sucker still adhering to the stone.

Experiment 5.—Another tendril with eight suckers, at 4 lbs. all were broken similarly to above case, but the suckers remained unaffected.*

* In such a case as this of Ampelopsis, art and nature are strongly contrasted. The gardener with his cloth and nails can never fit the plant accurately to the inequalities of a wall, but in nature this is admirably effected. After the gardener has fixed his branch, every day has a tendency to allow greater latitude to its movements, while by the marvellous provision in nature of the contraction of the branches of the tendril they become day by day more closely drawn inwards. Again, the material used by the gardener is slowly but surely destroyed by constant exposure, while in nature, as we have seen, the longer the exposure the stronger the support becomes. To call these wonderful properties acquirements made by the plant itself, as Darwin would have it, and thus to attribute high mental qualities to the vegetable world, as my friend Dr Lauder Lindsay has done, is in my opinion equivalent to giving God's glory to another. The truth is at once clearly and beautifully expressed by the well-known words of the poet in reference to the coral polypes, which, *mutatis mutandis*, apply equally here:—

> "Omnipotence wrought in them, with them, by them.
> Hence, what Omnipotence alone could do,
> Worms did."

Facts similar to those which are supposed to justify the attribution of mind to plants are observed also in inorganic nature; thus the diffusion of gases, which acts in direct opposition to the force of gravity, and which secures the continued respirability of our atmosphere, is no less a proof of mind and design than are the phenomena observed in plants. The operations of mind are undoubtedly manifest throughout all nature, but it is the mind of the Creator who also sustains all things by the word of his power; and our ability to discover these proofs of mind is only a fresh testimony to the old revealed truth, that man was made in the image and likeness of God, in so far as *knowledge* at least is concerned.

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Under the Sapindaceæ Darwin instances the *Cardiospermum Halicacabum*. We have only had one opportunity of studying a species of Cardiospermum from Mauritius, but as it was in a weakly condition and never flowered, we had no means of observing for ourselves many of the points to which Darwin alludes, but what we did observe fully corroborated the statements made by him. The flower peduncle terminates in three branches, the two lateral being the tendrils which, though at first straight, ultimately curl downwards, and in some cases, as where they caught no object, form a close and beautiful helix. The central branch divides and subdivides, and bears the flowers, but in some instances the homology is still farther declared by the three branches producing flowers. The movements of their upper internodes and of the peduncles bring the tendrils ultimately into contact with some twig or other body round which it curls. The value of having these organs of prehension and support so near the fruit has been well shown by Darwin, for "the seed-capsules, though light, are of enormous size (hence its English name of balloon vine), and as two or three are carried on the same peduncle" they are thus prevented from being dashed to pieces by the wind.

Paullinia thalictrifolia is at present being studied by me, but I have nothing definite as yet to report.

Darwin's account of the tendril-bearers is befittingly closed by introducing the Passifloraceæ. The tendrils in this order are also modified flower peduncles. One of Mr Darwin's sons found a very young tendril of *P. floribunda* with traces of floral organs at its summit. *Passiflora gracilis* (if we except *P. acerifolia*) is *facile princeps* of all twining plants, as the revolutions of its internodes are more rapid, and its tendrils endowed with more sensibility. Sometimes, indeed, as Darwin has shown, 57 or 58 minutes have sufficed for a revolution. The extreme sensitiveness is manifested only when the tendril is nearly fully developed, and at that period the most delicate touch or pressure causes a response. This effect has been noted when only $\frac{1}{50}$ grain has been placed upon its tip. Nor is this sensitiveness or irritability easily exhausted, for Darwin found

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that in 54 hours it responded to the stimulus twenty-one times.

In *Passiflora punctata* the movement of the tendril was considerably accelerated when approaching the light, the semicircle towards the dark part of the room requiring 15 or 20 minutes longer than that in the opposite direction.

The tendrils in this genus are sometimes of considerable length; thus, one from *P. racemosa* when the spiral was straightened measured 9½ inches, and the delicacy of the spirals and their perfect uniformity is a most pleasing object to contemplate. In one instance a tendril of *P. racemosa* had encircled a stick two or three times, and spirals began to show themselves at the part of the tendril next the stick, and in two days afterwards eight or nine spirals had formed.

As regards hook-climbers little need be said; sometimes, as in brambles and roses, &c., they seem to be the only means by which these plants can retain the positions which they may have reached in thickets, but in other cases the hooks are something superadded to some efficient mode of climbing, as we have seen in *Smilax aspera* and *officinalis*, and also in *Smilax deltoides*.

The root-climbers in some instances exhibit most interesting phenomena, and the description by Darwin of the roots of *Ficus repens* brings some of these most strikingly before us. He found that when it climbed up a wall, the young rootlets emitted a clear fluid of a slightly viscid character, which when removed from the root was very difficult to dry, some remaining still liquid at the end of 128 days. When left in contact with rootlets, however, the watery particles seemed to be absorbed, and a strong cement was formed. The cement was soluble in bisulphide of carbon, and seemed to be a kind of caoutchouc. We know that *Ficus elastica*, *F. indica*, and *F. religiosa* (or *Urostigma elasticum*, *indicum*, *religiosum*, as they are named by some) abound in caoutchouc, so that it is not unlikely that in *F. repens*, and also in *F. barbatus*, this substance may exist and be utilised.

Vanilla aromatica gives off aerial roots, which, according to Mohl, wind like tendrils round a thin support should they meet with it. Darwin says the roots are a foot in

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length, but Mr Lindsay called my attention to a root of *V. planifolia* in a hothouse, which passed straight downwards into a water tank, and which on measurement, was found to be 9 feet 7 inches, and though this seemed to be the longest, yet others in its immediate neighbourhood (but not passing into the tank), did not fall far short of it in length, one being 7 feet 10 inches. *Hedera Helix* is of course the best known among us of the plants whose ascent is secured exclusively by roots; but there are other plants to which the roots merely supply supplemental organs, and sometimes these are comparatively small, as in *M'Fadyena*, but at other times, as in *Hoya carnosa*, I have found them covering a large portion of a wall, and from the commencement of one of these roots to its termination, it measured 2½ feet.

Such is a necessarily imperfect sketch of the contents of the last volume from Darwin's pen, but I trust enough has been said to prove that an interest of no ordinary kind surrounds the plants that climb, and I do hope that many of our Fellows who have the time and opportunity may make observations, and record them from time to time to this Society. It is an inviting field, and notwithstanding all that Darwin and others have done, many sheaves may yet be borne from it, for the climbing plants and all their peculiarities are "the wondrous works of Him who is perfect in knowledge," Job xxxvii. 16; and whose "understanding is infinite," Ps. cxlvii. 5.

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13*th April* 1876.—Sir ROBERT CHRISTISON, Bart., in the Chair.

The following Paper was read :—

Observations on the Effects of Cuca or Coca, the Leaves of Erythroxylon Coca. By Sir ROBERT CHRISTISON, Bart.

The brief notice taken in my introductory address to this Society in November last, of the restorative and preservative virtues of the Peruvian cuca or coca-leaf against bodily fatigue from severe exercise, has led to numberless references to me by friends and strangers in all parts of the kingdom for information as to its effects, its safety, its applicability to the treatment of some states of disease, and the quarters in which it may be obtained. As I am not aware of any trials of it having been made in this country, either earlier than mine or so extensive, and as I shall probably best answer the many inquiries sent me by publishing an account of these experiments, I have been induced to present the following narrative to the Botanical Society. The inquiry, of which my recent trials forms a part, is very far from being complete, because my supply was quite inadequate till the other day, when I received a sufficiency through the kind services of my colleague Professor Wyville Thomson, of the "Challenger" expedition. But the facts already obtained will probably interest not a few at the present time, were it for no more than that they set at rest all doubts that the more important of the effects of cuca, experienced in its own country by the natives of Peru and the neighbouring states, may be equally produced in Europeans at home ; and that, contrary to what seems universally believed in Peru, the virtues of the leaf may be preserved with due care for many years.

In the first place, however, let me remark that I have ventured to restore to the commercial article its original name, *Cuca.* This was its Indian name, which the Spaniards corrupted into coca. But there is no reason why other nations should adopt a Spanish corruption; and

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there is a very good argument against transferring it to our own tongue, inasmuch as we have already two totally different vegetable products, cocoa and cacao, which, as indiscriminately pronounced in ordinary speech, coco and coca, are undistinguishable from the corrupt name of this new invention. I hope, therefore, that others will second me in attaching a characteristic name to an article which seems very likely to come ere long into general use among our countrymen at home.

The early historians of Peru have taken special notice of the culture, properties, and uses of cuca. Among these, none is more full, clear, and fair, than the famous chronicler of the reign of the Yncas and of the Spanish conquest, Garcilasso de la Vega.* His narrative bears internal evidence of great historical care. His information was derived partly from what he personally knew, partly from a Spanish priest, Blas Valera, who was long in Peru, and whose manuscripts came into the historian's possession.

G. de la Vega informs us that the use of cuca in Peru dates from an early period of the dominion of the Yncas; and that at first it was scarce, and was monopolised by the monarchs themselves. But, as the Yncas extended their conquests northward along the Cordilleras of the Andes, the culture of the plant also became much more widely extended, through the acquisition of suitable lands for the purpose; and the leaves came gradually into more general use. The Spaniards, however, were too devoted Catholics to fall into a custom which was the offspring, and continued to have the savour, of profane heathen rites. The chewing of cuca was detested by them, condemned by public opinion, and charged with being baneful to the health of those who gave themselves up to it. Strong prejudices thus prevailed regarding it; against which, however, Garcilasso de la Vega and Blas Valera strongly protested. Nowhere does the author of the "Royal Commentaries of the Yncas" say one word of the evil consequences actually resulting from the use of this vegetable becoming a habit.

* "The Royal Commentaries of the Yncas." By the Ynca Garcilasso de la Vega, 1609–1617. Translation by Clements R. Markham, C.B. London, 1871.

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In face of the opposition it received from subsequent authors, and from some modern travellers, this testimony of Garcilasso de la Vega may be received with favour. He was son of one of Pizarro's conquering captains of the same name, by a niece of one of the last of the Yncas. He would therefore escape the tendency of the pure Spanish race to vilify the manners and customs of the people they had subdued; and his native and royal extraction gave him access to full information on such a subject. It is true that he left the land of his birth at the age of twenty (in 1550), and passed the remainder of a long life in Spain. But a youth of his family extraction on both sides was old enough to take part in the stirring events of the period while he remained at Cuzco; and, after leaving it for Spain, he kept up correspondence with the friends he left behind him, collecting from them information for his history.

I was first led to pay attention to the Peruvian custom of chewing cuca by reading, full forty years ago, the "Travels in Chilé, Peru, and on the River Amazons," of the German naturalist Pöppig, who has taken a very different view of this national custom from Garcilasso de la Vega and Blas Valera.* Pöppig was no less than five years in these regions, from 1827 to 1832, and passed much of his time among the cuca-chewers in the forest regions of the Peruvian Andes. Probably no European in the present century had such opportunities of intimately studying the habit. His statements of fact and his opinions are therefore entitled to much consideration.

The conclusion at which he arrived is, that the habit is as seductive and as injurious to health, mind, and morals, as that of tippling in Europe, or opium-eating in the East. He says it is almost confined to natives of the aboriginal red race, has not been adopted by negroes, and is discountenanced among all of European descent; that even those who use it to no great excess must stop their work several

* Pöppig "Reise durch Chilé, Peru, und auf dem Amazonenstrome," 1827-32. Berlin, 1835. I am not aware that this interesting work has ever appeared in an English dress; but a translation of that part which relates to the culture and use of cuca may be seen in Hooker's "Companion to the Botanical Magazine," 1835, ii. 161.

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times a-day to chew their quid contemplatively, and are much displeased if disturbed in their placid enjoyment; and that those who have got thus far are apt to become mere slaves to it, surrender every other occupation for it, and, quitting society, pass their time in the wild forests between hunting for their sustenance and lying under a tree chewing their beloved weed, calling up delightful visions and building castles in the air, and so insensible to outward occurrences as to remain thus all night indifferent to cold, torrents of rain, and even the howlings of the panther in their neighbourhood. But, in the end, life is cut short about the age of fifty by obstruction, dropsy, or jaundice, or through simple extenuation and exhaustion. When the habit has thus degenerated into a vice, the victim becomes, in the language of the country, a Coquero, and is irreclaimable. If a man of Spanish blood begin to use cuca, he is at once looked on with suspicion; for usually, in the course of time, he abandons himself entirely to it, and becomes an outcast from the society in which he moved.

It is unnecessary to follow Pöppig through the arguments and illustrations, very interesting, however, by which he was led to denounce cuca as a deceitful and destructive stimulant of the narcotic kind. He allows nevertheless, that it has really wonderful power in supporting the strength under prolonged fatigue without food. He mentions that, in his long rides through the Peruvian forests, he had seen his Indian followers accompany him on foot for fifty miles in one day, without food, or anything else except cuca; and that in the revolutionary wars which ended with the Spanish American States throwing off subjection to old Spain, the native Peruvian troops, poorly clothed and ill fed, were able to fall upon their enemies by surprise, by making long marches among the mountains without food or sleep, merely resting for intervals of a few minutes occasionally to refresh themselves by cuca-chewing. He adds an important fact, which I am able to confirm, that, when his day's journey came to an end, he did not find his Indian attendants had at all lost their appetites; for, when done with work for the day, although they did not care for food while travel-

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ling and chewing, they made an excellent meal in the evening.

Three very able observers, who have since spent some time as naturalists in Peru, and became familiar with the fondness of the natives for the cuca-leaf, have treated the question minutely; and they separately bear witness to the soundness of the views of Garcilasso de la Vega and Blas Valera, and to some mistake on the part of Pöppig, for which it is not easy to account. It is important to see to what their testimony exactly amounts. For the Peruvian habit has been said to be nearly universal among a population of nearly eight millions inhabiting the Andes; and the annual collection of the leaf has been estimated at no less than thirty millions of pounds.

In 1838 Dr von Tschudi visited Peru, and was for some time in the neighbourhood of various districts, where the natives of Indian race almost universally use cuca, and where he himself repeatedly made trial of it.*

Dr Weddell of Poitiers, who had previously investigated with singular success in Upper Peru the botany of the cinchonas, and was the first to discover there the true yellow bark tree, the most valuable of them all, revisited Bolivia in 1851, where, in the province of Yungas, the finest cuca is said to be cultivated. He, too, made trial of it himself, and had very ample opportunities of witnessing its use and its effects among the Peruvians.†

In 1860, Mr Clements Markham, who had charge of the Government expeditions to Peru in quest of cinchona plants for cultivation in India, was much in the wildest forest districts of Lower Peru, immediately adjoining Bolivia, was always attended by cuca-chewing natives, and not unfrequently followed their example.‡

All these authorities, undeniably of the first rank, agree that the repulsive accounts of Pöppig are much exaggerated. The general result of their experience is to raise a suspicion that, in a few instances, his deplorable history of

* "Travels in Peru, &c., during 1838–42." By Dr T. I. von Tschudi. Translation by Thomasina Ross. London, 1847.

† "Voyage dans le Nord de la Bolivie, &c." Par H. A. Weddell. Paris, 1853.

‡ "Travels in Peru and India." By Clements R. Markham. London, 1862.

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the abandoned irreclaimable coquero may not be far from the truth. But they do not seem to have themselves met with any such cases. Von Tschudi, indeed, says, that a profligate coquero may be known by his foul breath, stumpy teeth, pale quivering lips, black-coloured mouth, dim eyes, yellow skin, unsteady gait, and general apathy; but, in his narrative, obviously in part compiled, he does not say he described such a man from actual observation; on the contrary, all three travellers represent in colours more or less strong the great utility of cuca to the Indians in the hard labour they have to undergo.

Von Tschudi observes that, in his own trials, he found it to be a preventive of that difficulty in breathing which is felt in the rapid ascent of the Andes. He mentions the following instance, which he carefully watched, of the power of the Indians to bear long fatigue without any other sustenance. A miner, sixty-two years old, worked for him at laborious digging five days and nights without food, or more than two hours of sleep nightly, his only support being half an ounce of cuca leaves every three hours. The man then accompanied him on foot during a ride of sixty miles in two days. Nevertheless, von Tschudi was assured by the priest of the district that he had never known the man to be ill.

In general terms, this traveller declares he is "clearly of opinion that the moderate use of cuca not only is innocuous, but may even be conducive to health;" and, again, he observes, "after long and attentive observation, I am convinced that its use in moderation is nowise detrimental, and that without it the poorly fed Peruvian Indian would be incapable of going through his usual labour. The cuca plant must be considered a great blessing to Peru."

Weddell, in less glowing terms, says, that careful inquiry where cuca is most in use satisfied him that it might be injurious to Europeans not gradually accustomed to it; but that it has the power of sustaining the strength for a time without food, yet without interfering with the appetite soon afterwards; that, in his own trials, he experienced a slight excitement and a little subsequent sleeplessness, but nothing else; and that, in the countries he visited, he

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never saw things go the length described by Pöppig, who must have been misled by exceptional cases.

The testimony of Clements Markham is very explicit. He says the properties of cuca are to enable a greater amount of fatigue to be borne with less nourishment and to prevent difficult breathing in the ascent of steep mountain sides; that, although when used to excess it is prejudicial to the health, yet "of all the narcotics used by man, it is the least injurious and most soothing and invigorating;" that he chewed it frequently, and, besides an agreeable soothing feeling, found he could endure long abstinence from food with less inconvenience than he should otherwise have felt; and that it enabled him to ascend precipitous mountain-sides with a feeling of lightness and elasticity, and without losing breath. "It enabled him to ascend the mighty passes of the Andes with ease and comfort."

It is difficult to reconcile with these favourable opinions the very opposite conclusions of Pöppig, founded apparently on personal observation. Probably, he was too prepossessed with the abhorrence with which the practice of chewing cuca was regarded by the white inhabitants of the towns; hence he might have mistaken for the effects of the habit what perhaps was no more than the physical expression of the natural indolence of the Indian race when indulged in to excess; or, in other cases, the result of over-indulgence in ardent spirits, which, he says, the coquero sometimes adds to his other vices.

The shrub which produces cuca thrives best in the clearances in the elevated forests of the Andes, in a climate distinguished by frequent rain-showers, and exemption equally from frosts and from extreme heats. In due season it is covered with clusters (fascicles) of delicate white flowers, which give it the appearance of our blackthorn in spring; and the flowers are succeeded by red berries.* The plants bear stripping of their leaves three times in the course of the year. Great care is usually taken to nip them off without hurting the axillary buds.

* A specimen of the plant is now in flower in the Edinburgh Botanic Garden (April 18th). It is well represented in an uncoloured engraving in Hooker's "Companion to the Botanical Magazine," ii. 25, 1836.

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They are dried at once quickly and thoroughly, and so as not to curl; at least, all good specimens I have seen present the leaves flattened and many of them entire, almost as if intended for a herbarium. Great care is taken to keep them afterwards dry, when transported from place to place. When newly dried, they have a strong odour, which is said to be apt to cause headache in those who frequent the drying-floors for the first time; but this odour passes off by the time the leaves are packed. The packages when opened have a powerful tea-like odour; which they retain on reaching Europe, if duly protected from damp. In Peru it is alleged that their properties soon deteriorate, that in a few months they lose much of their virtue, and that when taken to the coast they are worthless in twelve months. This statement, however, must be received with some limitation. It is evident, from the pains taken in Peru to preserve them from damp and exposure, that the leaves are easily damaged without due precaution; so that neglect will account for the inferiority of many old samples. Besides, it is contrary to all analogy, that leaves destitute of volatile oil, at least not owing their virtues to volatile oil, should lose them under careful preservation from the ordinary causes of decay; and various medicinal leaves of European growth, formerly thought to become inert by keeping, are now known to retain their properties very long, since we have been aware of the precautions for preserving them. Further, specimens brought to Europe have been found to yield a crystalline principle, which physiologically possesses no mean activity as a narcotic, which is probably the acting ingredient, and which apparently bears transport and long keeping well. Lastly, well-preserved cuca will produce in Europe in no small degree, after being kept several years, the remarkable effects on man which are every day experienced in Peru.

Cuca is not yet a regular commercial article in this country. In the prospect of its soon becoming so, the characters of a good sample should be well understood. I have had two fine specimens of it, and have seen several evidently much inferior. The fine qualities consist of leaves in a great measure unbroken, often folded, but many of them too spread out, never curled, but always flattened,

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never brown, always deep green on their upper and grey-green on their under surface, and uniform in that respect, seldom mottled in colour. They are thin and crisp, beautifully reticulated, and traversed longitudinally by a single fine vein on each side of the strong midrib. In mass they have a strong odour resembling that of tea, and when chewed they have a peculiar well-marked herbaceous taste, not disagreeable, followed, after continuous chewing for some minutes, by a gentle, pleasant sense of warmth in the mouth. Inferior specimens, besides differing in appearance from these, have a fainter odour, and do not occasion warmth in the mouth when chewed.

Cuca has been subjected to chemical analysis, and found to contain a crystalline principle, to which naturally has been given the name of Cocaïne. But it is not my intention to enter here into the chemistry of the subject.

Nor is the Botanical Society the fit place for discussing fully the experimental investigations which have been made into the physiological actions of cocaïne, or of coca itself, further than as they bear on what has been said above upon that point, or on what is to follow as the account of my own observations. In that respect, the most important inquiry is that of Dr Mantegazza of Milan, published in a prize essay, which has been noticed in the "Oesterreichische Zeitschrift für Praktische Heilkunde" for November 1859. He found, by personal trials, that in small doses it promotes digestion, increases the frequency of the pulse, raises the animal heat, and accelerates respiration; that in a dose somewhat larger, there is added a facility of motion and desire for it, succeeded by a soothing effect; and that in a large dose, such as three drachms or upwards, it doubles the rate of the pulse, causes flashes of light, headache, strong tendency to muscular action, and great vigour of mind, succeeded by a state of pleasing, imaginative calm, described by him in brilliant colours, which resemble the poetical ravings of De Quincey, in representing the visionary musings of the opium-eater.

Were these effects the general rule, there would be more justice in the unfavourable representations of Pöpping than has been hitherto admitted. I scarcely think the recently ascertained deadly effects of the principle cocaïne

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upon animals can be fairly added to the evidence in the same direction. It is true that experimental inquiries, and, among these, the most recent by Dr Alexander Bennett, published in his thesis, and also as part of an experimental research carried on by a committee of the British Medical Association,* prove that in small animals cocaïne produces in an adequate dose paralysis of sensation, tetanic convulsions, and death. But he found the same effects to be caused by theïne, caffeïne, theobromine, and guaranine, the nearly identical crystalline principles of tea, coffee, chocolate, and the Brazilian guaranà; yet no one will imagine on that account, that the habitual use of these restoratives has any injurious influence on the health. At all events, however, the following experiments, with doses little short of those which are stated to have acted so extraordinarily in the case of Dr Mantegazza, show results materially different from his, and prove that the leaves may be easily used by most, if not all, persons, so as to produce no unpleasant, unsafe, or even suspicious effects whatsoever.

My first trials were made in 1870, when I was not aware that any one else in Europe had experimented with it. My specimen was sent to me by a London mercantile gentleman, Mr Batchelor, six years before, and must therefore have been kept for seven years at least. The leaves had been excellently dried, flat, unbroken, and green; and they had been equally well preserved by sprinkling a little quicklime among them before being shipped. Even in 1870 they were green, brittle, and strongly-scented. Two of my students, out of the habit of material exercise for five months, tired themselves thoroughly with a walk of sixteen miles in the month of April. They returned home at their dinner hour, having taken no food since a nine o'clock breakfast. They were very hungry, but refrained from food, and took each an infusion of two drachms of cuca, made with the addition of five grains carbonate of soda, which was added to imitate the Peruvian method of chewing the leaves along with a very small quantity of lime or plant ashes. I am satisfied, however, that any such addition is superfluous. Presently hunger left them entirely, all sense of fatigue soon vanished, and they pro-

* "Edinburgh Medical and Surgical Journal," 1874, Part ii. p. 328.

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ceeded to promenade Princes Street for an hour; which they did with ease and pleasure. On returning home their hunger revived with great intensity; they made an excellent dinner; they felt alert all the subsequent evening, slept soundly all night, and next morning awoke quite refreshed and active. One of them, in setting out for the evening promenade, felt very slightly giddy, as if he had taken just a little too much wine. But the other experienced no other sensation than the removal of fatigue, and ability for active exertion.

Having subsequently received from Dr Alexander Bennett a larger supply, obtained by him in Paris, I made further trials in the spring of last year (1875). This sample was more broken, less green, less scented than the other, less strong in taste, and scarcely producing any sense of warmth in the mouth when chewed. Obviously it was of lower quality. Ten of our students made trial of it under conditions precisely similar to those observed in the prior experiment; and they reported the results to me severally in writing. Their walks varied between twenty and thirty miles, and three cleared the latter distance on a rather hilly road at nearly 4½ mile pace over all. Two were unable to remark any distinct effect from the cuca. Several felt decided, but only moderate, relief from fatigue. Four experienced complete relief, like their predecessors in 1870; and one of these had walked thirty miles without any food. All found their hunger cease for a time; but shortly afterwards neither appetite nor digestion was at all impaired. No disagreeable effect was produced at the time or subsequently, except that a few felt a brief nausea after their dose, owing probably to the form of infusion in which it was taken.

I then determined to make some careful personal trials with the scanty remains of my best specimen. For this purpose I thought it best to adopt the Peruvian method of chewing, but I discarded their lime and ashes. For not only was I unable to discover, in the nature, composition, or effects of the leaf, any chemical or physiological reason for such addition, but likewise I found that the Llipta, as the addition is called, which was presented to me with one of my specimens from Peru, has no alkaline or calcareous

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taste, and therefore cannot effect decomposition of the leaf while it is masticated. The result confirms the view I had thus taken.

I had first to ascertain what amount of exercise was required to cause very thorough and permanent fatigue. At the same time, I made such observations on certain of the functions as seemed desirable and easily practicable. In the beginning of May, under a day temperature of 58°, I walked fifteen miles in four stages, with intervals of half-an-hour, at four-mile pace, without food or drink, after breakfast at half-past eight, and ending with a stage of six miles at half-past five in the afternoon. I had great difficulty in maintaining my pace through weariness towards the close, and was as effectually tired out as I remember ever to have been in my life, even after thirty miles at a stretch forty or fifty years before.* Perspiration was profuse during every stage, particularly the last of all. The pulse, naturally 62 at rest, was 110 on my arrival at home; and two hours later it was still 90. I was unfit for mental work in the evening, but slept soundly all night, and awoke next morning somewhat wearied and disinclined for active exercise, although otherwise quite well. Two days afterwards I repeated this experiment, and obtained precisely the same results.

Four days later, with precisely the same dietary, I walked sixteen miles in three stages of four, six, and six miles, with one interval of half-an-hour, and a second of an hour and a half. During the last forty-five minutes of the second rest, I chewed thoroughly eighty grains of my best specimen of cuca, reserving forty grains more for use during the last stage. To make assurance doubly sure, I swallowed the exhausted fibre, which was my only difficulty. On completing the previous ten miles, I was fagged enough to look forward to the remaining six miles with considerable reluctance. I did not observe any sensible effect from the cuca till I got out of doors, and put on my usual pace; when at once I was surprised to find that

* The degree of fatigue thus occasioned by no great amount of exercise was owing partly to the experimentalist having been quite out of the habit of much exercise for five months, and partly to his having to carry the weight of seventy-eight years.

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all sense of weariness had entirely fled, and that I could proceed not only with ease, but even with elasticity. I got over the six miles in an hour and a half without difficulty, found it easy when done to get up a four-and-a-half mile pace, and to ascend quickly two steps at a time to my dressing-room, two floors upstairs; in short, had no sense of fatigue or other uneasiness whatsoever. During the last stage I perspired as profusely as during the two previous walks. On arrival at home, the pulse was 90, and in two hours had fallen to 72; the excitement of the circulation being thus much less, and its subsidence more rapid, than after the same amount of exercise without cuca.

On arriving at home before dinner, I felt neither hunger nor thirst* after complete abstinence from food and drink of every kind for nine hours; but on dinner appearing in half an hour ample justice was done to it. Throughout the evening I was alert, and free from all drowsiness. Two hours of restlessness on going to bed I ascribed to the dose of two drachms being rather large; and after that I slept soundly, and awoke in the morning quite refreshed, and free from all sense of fatigue, and from all other uneasiness. Another effect not unworthy of notice, was that a tenderness of the eyes, which for some years has rendered continuous reading a somewhat painful effort, was very much mitigated during all the evening.

I reserved what remained of my good specimen of cuca for further trial during my autumn holidays in the country. On September 15th, while residing at St Fillans on Loch Earn, I ascended Ben Vorlich. The mountain is 3224 feet above the sea, and 2900 above the highway on the loch-side. The ascent is for the most part easy, over first a rugged footpath, and then through short heather and short deep grass; but the final dome of 700 feet is very steep, and half of it among blocks and slabs of mica slate, the abode of a few ptarmigan, of which a small covey was sprung in crossing the stony part. On the whole, no Highland mountain of the same height is more easily ascended. The temperature at the side of the lake was

* Perhaps it should be mentioned that at all times I have been exempt from thirst, under a long day's continuous exercise.

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62°; on the summit, 52°. In consequence of misdirection, I had to descend an intervening slope on the way, so that the whole ascent was 3000 feet perpendicular. I took two hours and a half to reach the summit, and was so fatigued near the close that it required considerable determination to persevere during the last 300 feet. I was richly rewarded, however, by an extremely clear atmosphere, and a magnificent mountainous panorama, of which the grandest object was Ben Nevis, forty miles off, shown quite apart from other mountains, and presenting the whole of its great precipice edgeways to the eye. My companions, who, as well as I, were provided with an excellent luncheon, soon disposed of it satisfactorily; but I contented myself with chewing two-thirds of one drachm of cuca leaves. We spent three-quarters of an hour at the top, during which I looked forward to the descent with no little distrust. On rising to commence it, however, although I had not previously experienced any sensible change, I at once felt that all fatigue was gone, and I went down the long descent with an ease like that which I used to enjoy in my mountainous rambles in my youth. At the bottom, I was neither weary, nor hungry, nor thirsty, and felt as if I could easily walk home four miles; but that was unnecessary. On arriving home at five o'clock, I still felt no fatigue, hunger, or thirst. At six, however, I made a very good dinner. During the subsequent evening I was disposed to be busy, and not drowsy; and sound sleep during the night left me in the morning refreshed and ready for another day's exercise. I had taken neither food nor drink of any kind after breakfasting at half-past eight in the morning; but I continued to chew my cuca till I finished the sixty grains when halfway down the mountain.

Eight days afterwards I repeated the experiment, but used ninety grains of cuca. Being better acquainted with the way, no ground was lost by an intervening descent, so that the perpendicular height to be reached from the highway was 2900 feet. I took two hours and a quarter to ascend, and on reaching the summit was extremely fatigued. The weather had changed, so that the temperature, 51° at the loch-side, was 41° at the top. A

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moderate breeze consequently caused so much chilliness that my party were glad to redescend in half an hour, by which time I had consumed two-thirds of the cuca, taking, as formerly, neither food nor drink. The effects were precisely the same, perhaps even more complete, for I easily made the descent without a halt in an hour and a quarter, covering at least four miles of rugged ground; and I walked homewards two miles of a smooth level road to meet my carriage. I then felt tired, because nearly three hours had elapsed since I consumed the cuca, and in that time the Peruvians find it necessary to renew their restorative. But there was no more cuca left, and I was tempted to substitute a draught of excellent porter. I suppose this indulgence led on to the unusual allowance of four glasses of wine during dinner, instead of one or none; and the two errors together, with possibly some discordance between cuca and alcohol, were the probable cause of a restless feverish slumber during the early part of the night; but quiet sleep succeeded, and I awoke quite refreshed and active next morning.

One of my sons, who accompanied me on both occasions, used cuca the first time, but also took luncheon on the summit. Though not in good condition for such work, he made it out without fatigue; and on the second occasion, when there was no more cuca to give him, he felt decidedly the want of it when he reached the highway at the foot of the mountain.

These trials have been described particularly, because I feel that, without details, the general results, which may be now summarised, would scarcely carry conviction with them. These are the following:—The chewing of cuca removes extreme fatigue, and prevents it. Hunger and thirst are suspended; but eventually appetite and digestion are unaffected. No injury whatever is sustained at the time, or subsequently in occasional trials; but I can say nothing of what may or may not happen if it be used habitually. From sixty to ninety grains are sufficient for one trial; but some persons either require more, or are constitutionally proof against its restorative action. It has no effect on the mental faculties, so far as my own trials and other observations go, except liberating them from the

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dulness and drowsiness which follow great bodily fatigue. I do not yet know its effect on mental fatigue purely. As to the several functions, it reduces the effect of severe protracted exercise in accelerating the pulse. It increases the saliva, which, however, may be no more than the effect of mastication. It does not diminish the perspiration, so far as I can judge. It probably lessens the hourly secretion of urine-solids. On this point, however, I cannot yet speak with any confidence.

I have made no trials of the influence of cuca on disease, or the consequences of disease. Some notices in the journals on this subject show that it is attracting attention; but, so far as I see, it is a difficult one, and may prove extensive, and therefore it ought to fall into the hands of some able inquirer, who will be in no hurry to rush into print. I have been asked by correspondents in the south of England if cuca will do good to a weak heart, to an old paralysis, to the feebleness of advancing age, &c. My reply has been, that I know nothing of all this, and that no one should use it medicinally, but under the advice and observation of his medical attendant.

A more convenient form for use than that of a quid is very desirable. M. Laumaille, who rode, or on very bad roads led, his bycyle 760 miles from Paris to Vienna in little more than twelve days, in the month of October, carried with him, as part of his scanty baggage, "a small supply of the *liqueur de coca*, an Indian tonic, by which he was always able to assuage the sudden and painful hunger which sometimes accompanies continued exertion."* Unfortunately he gives us too little of his experience with it; but he observes that, when about sixty miles from Vienna, "continuing his way along a road of fluid mire, fatigue and sleep at length told upon him, but the marvellous liqueur de coca again supported him and gave him strength."* I have made by rule of thumb a very palatable liqueur, with only a fourth of rectified spirit, and containing in half-an-ounce the soluble part of sixty grains of leaves, but I have not yet tested its virtue. Pharmaceutical chemists, however, will soon solve the problem, and, it may be hoped, without looking for a patent.

* "Paris to Vienna by Bicycle." By W. Saunders. Tinsley Brothers, London, 1875, pp. 5 and 28.

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11*th May* 1876.—Sir ROBERT CHRISTISON, Bart., President, in the Chair.

The following Paper was read:—

I. *Notes on the Growth of some Australian Plants in Arran.* By Rev. DAVID LANDSBOROUGH.

In the year 1861, a relative went to live at the beautiful residence of Cromla, at Corrie, on the east side of Arran, and I have been in the habit at all seasons of the year of going occasionally to see her. Owing to the mildness of Arran, and specially of the garden at Cromla, from its being separated from the sea at high water by only the breadth of the highway, many plants destroyed elsewhere by frost remained uninjured in it. I resolved by a few experiments to test its capabilities for the growth of exotics. The result I now submit to the Society.

In one sheltered corner, in 1867, I placed a small plant of the great Australian tree fern, *Dicksonia antarctica*, and in another a similar plant of that most beautiful of all tree ferns, the silvered *Cyathea dealbata*. The Cyathea grew beautifully during the summer, stood the winter perfectly, but was afterwards stolen. The Dicksonia has now nine fronds, the largest 4 feet long by 22 inches broad; it makes two growths in the year, in April and May, and again in September and October. It is of course an evergreen, and looks better in winter than in summer, when all the fronds are of full size. It has not yet begun to form a stem, but I understand that in its native clime it does not begin to do so till it has grown for about a dozen years. I may add, that within the last few weeks a magnificent strawberry tree, *Arbutus Unedo*, which sheltered it from sun and wind, has been blown down.

My next experiment was with the Beefwood tree of Australia, *Casuarina equisetifolia;* for a time it grew well, being little injured in winter. By-and bye, however, it began to decline. I removed it to the border which adjoined the sea; here it grew well in summer, but could not stand the blasts of winter. A second time I trans-

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planted it, but it had not sufficient vigour remaining to stand the operation.

Other plants were introduced, such as tender Fuchsias, Azaleas, Cytisus, &c.

In 1872 I purchased a number of packets of Australian Acacia and Eucalyptus seeds; having sown these I kept the plants for a year in the greenhouse, and planted them at Cromla in the spring of 1873, in the border next the sea, as being least exposed to frost, though they would suffer most from the north-east wind. There were four species of Acacia—*A. longifolia*, *stricta*, *Melanoxylon*, and *affinis*. All of them have grown well. The finest is *A. affinis*, whose exquisite and most delicate-looking feathery fronds render it the most beautiful of all the Acacias; and fortunately it is also one of the most hardy species.

The Gum Tree (Eucalyptus) seed—*E. globulus*, *pendula*, and another—were sown in a greenhouse in 1872. The last came up freely, but damped away; and though I sowed it repeatedly, the result was always the same. The Blue Gum, *E. globulus*, was planted at Cromla in 1873, but, in consequence of often losing its top, is now only about 11 feet in height. Another of the same sowing, however, has made great progress; I gave it to James Paterson, Esq., factor in Arran to the Duke of Hamilton. I measured it two days ago, in the wood behind Brodick Old Inn, and found the growths it had made as follows:—1st year, 11½ inches; 2d year, 4 feet 6 inches; 3d year, 6 feet 7½ inches; 4th year, 6 feet; in all 18 feet and 1 inch; and it would have been 20 feet high had its top not been blown off this year, for it is a good deal exposed to the west and south-west winds.

The third packet was named *Eucalyptus pendula;* the name is descriptive of the habit of the tree. The seeds grew well, but the plants exhibited two distinct varieties. The leaf of the one resembles in shape the Willow, only it has a curious inward twist; the leaves of the other are much darker, and are of the shape of those of the *Hypericum Androsæmum*. So like is it to the St John's Wort—resembling it also in the punctuation of the leaves—that when the Eucalyptus is young it might

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readily be mistaken for it. Both these differ from *E. globulus* in being devoid of that glaucous bloom, from which the Blue Gum takes its name. They also differ in the leaves being comparatively small, and the stems at all stages round, while one of the most striking features of *E. globulus* is the quadrilateral and quadrangular character of the young branches. I would, however, particularly direct attention to their great comparative hardiness. Last year I planted a good-sized specimen of *E. globulus* and another of *pendula* in front of my house in Kilmarnock, which is 7 miles from the sea, and the winter has been severe. The Blue Gum is killed to the ground, and is probably dead; *E. pendula* is little injured. I do not hesitate to predict that it will be hardy in all sheltered spots along the west coast, and I expect that in a few years it will be abundant in such places, forming a beautiful addition to the trees of the country. It is evergreen, of a fine dark hue; has a perfume as sweet as that of the gale; grows rapidly, is graceful in habit, the branches tapering to as fine a point as those of *Salix babylonica*, while it sends forth fresh leaves early; in a mild winter new shoots may be found in February an inch in length, and though these are probably nipped by frost, others soon appear. I cannot speak of the quality of the wood.

I may add that, through the kindness of Mr Paterson, I have been allowed to plant specimens of the species mentioned of Eucalyptus and Acacia in the wood at Brodick, where the Blue Gum has grown so rapidly.

My last experiments at Cromla have been with Palms. The first is so only in name; it is *Dracœna indivisa*—the Cabbage Palm of the Australian colonies, of whose leaves mats are manufactured. It has proved hardy. The other is a true Palm—one that grows in Australia to the height of 50 feet—the beautiful *Corypha australis*. It is not quite hardy, yet it has stood two winters without any protection, and I doubt not in a situation sheltered from the north and east it would be quite hardy also. I could have given it this shelter had I not been afraid of it being stolen, and thus planted it near the house, where it had not these advantages, nor had it that of being against a wall.

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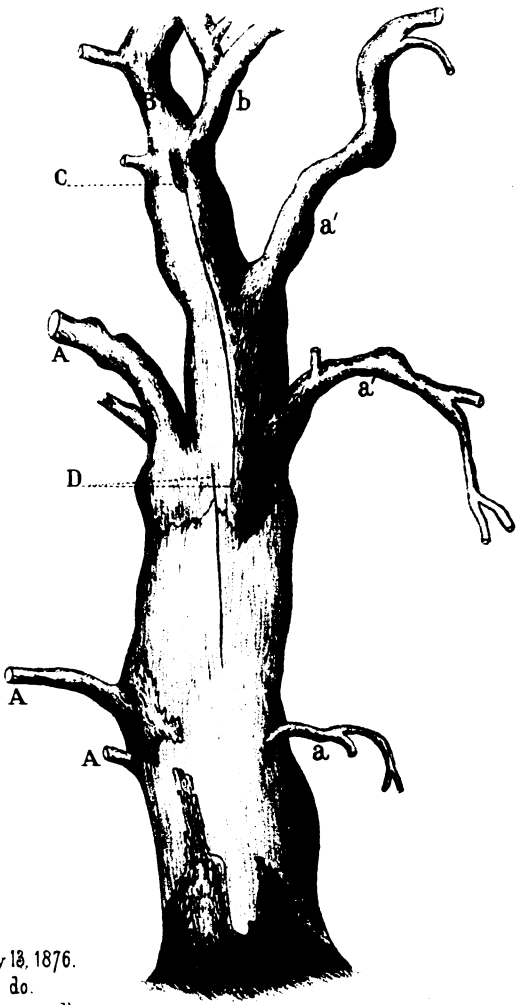

A,B No buds, July 13, 1876.
a. Foliage perfect do.
a'b. Backward foliage on all terminal twigs, July 13. 1876.
C. An old scar in the wood.
D. Site of chinks of light in the fissures.

from the South.

M.c Farlane & Erskine Lith.rs Edin.r

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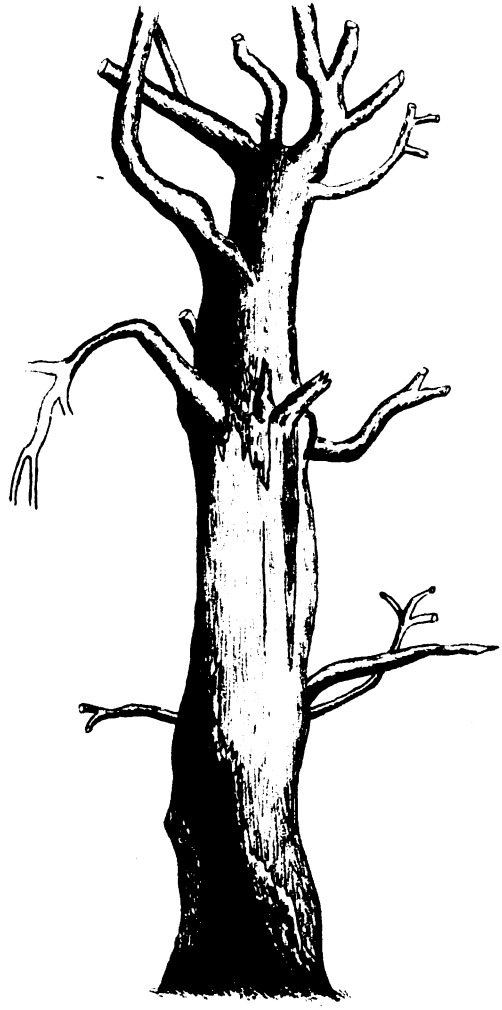

from the North.

M^c Farlane & Erskine Lith^rs Edin^r

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Thus ends my paper. My experiments at Cromla are also ended, for the kind old lady has last winter "gone the way of all flesh." I have not removed any of the plants I introduced to her garden. Mr Paterson has kindly ordered them to be protected, and others may yet tell how they have thriven.

I send specimens of the leaves and branches of *Eucalyptus globulus* and *pendula*. The growth of the Weeping Gum is about a third slower that of the Blue. The growth of the Acacia is not much less than that of the Weeping Gum.

13*th July* 1876.—Sir ROBERT CHRISTISON, Bart., President, in the Chair.

The following Communications were read :—

I. *Notice of a Tree Struck by Lightning.* By Sir ROBERT CHRISTISON, Bart., President of the Botanical Society. (Plates VIII. and IX.)

In July 1874, during a thunderstorm of severity unusual in this district, a large ash-tree, very near the toll-bar on the Dean Road, one mile from the west end of Princes Street, was struck with lightning. The tree is one of eleven hedge-row ashes directly opposite the toll-house, extending from the north wall of the road down a gently-sloping bank northwards. The first is a handsome leafy tree, the earliest of them all to push out buds in the spring. Then come two short stumps with some living shoots,—how thus destroyed I know not, but injured evidently when young, and probably owing to their free exposure to all westerly storms. The stricken tree is the fourth. The next is also an injured wreck. Three of the remainder are healthy, entire, and of considerable age ; a fourth is either much younger or ill-thriven ; and among these are two other stumps, like those already noticed, still putting out shoots. It is obvious that many accidents have happened to this row of trees, prior to that which I have undertaken now to describe.

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The particular tree at present in question grows on a slightly raised ridge, between the two lines of a double hedge, much the worse for neglect. It has a trunk about twenty-five feet high, and nine feet in girth at five feet from the ground, and spreading branches which reach to a height of about sixty feet. It is the thickest and tallest in the row; and, although a little down the slope, it rises several feet higher into the atmosphere than its nearest neighbour next the road, which stands on the top of the bank. That tree is thirty yards distant; the nearest thriving tree on the other side is thirty-two yards off; there is no other elevated object in the vicinity; and westward, in the direction whence came the storm, there is a long unbroken surface of agricultural fields. The tree therefore plainly stands much in the way of a westerly storm. The injury sustained by the tree is not unworthy of notice, because it appears to be the least frequent of the damages done to forestry by lightning, and the damage done is very great, and its effects deserve to be watched and recorded.

At least three kinds of injury have been observed from lightning. Sometimes the electric fluid, entering the trunk blows it to shivers, and brings down in a moment the whole leafy superstructure. Sometimes it rips the bark in one or more lines from the point of impact down to the ground, occasionally tearing off a narrow strip of bark, and amputating also any branch it encounters in its descent, or otherwise so damaging the tissues connecting the branch with the trunk, that the branch dies. Sometimes it seems to sweep around between the wood and the bark, throwing off the bark in great sheets round and round the whole girth of the tree. It is also often said to amputate branches without other damage. This is not probable, however; and such simple injuries may be owing rather to the furious temporary hurricane which often attends a thunderstorm, and which must have great aid in its devastations from the fulness of vegetation at the usual season of thunder.

Of the first mode of stroke, involving instantaneous demolition of the whole tree, a very remarkable instance occurred in or about the year 1848, four miles S.E. from Edinburgh, close to Edmonstone House, the seat of Sir

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John Don Wauchope, Bart. It so happened that a marriage ceremony was going on at the time in the house. Some of the bridal party, looking out upon the lawn into the deepening gloom of the approaching storm, saw a magnificent wide-spreading oak, eleven feet in girth of trunk, struck by a flash, and instantly sink to the ground, leaving only a portion of the central part of the trunk standing upright through the ruins, like a perpendicular pile of white planks. I saw the wreck two days afterwards. The great limbs lay around the riven trunk in their original arrangement, pinning to the ground with their massive elbows white planks from the trunk, four to ten feet long, six or eight inches wide, and shaped some of them as if they had come from the carpenter's shop; and in one direction several similar planks lay outside the wreck altogether, at a distance of 108 feet from the trunk. It is easy to see how destruction was effected here.

The second process tears open the bark in a direct line from the point struck to the ground, and often removes a narrow strip of bark. But it may do no farther damage unless the electric fluid encounter in its course a branch, which it breaks off, or shatters, or so injures at its attachment that it subsequently dies. Nor in that case is serious harm done eventually to the tree. This seems the commonest consequence of a lightning-stroke. There is an excellent instance in this very garden. A lime-tree (*Tilea europœa*, var. *intermedia*) standing close to what was intended for a magnetical observatory, was struck about thirty-five years ago. The electric blow appears to have hit at the same time two neighbouring branches. On one the current had descended straight down to the north-west side of the trunk, and thence in a straight line to the ground. On the other it had run down in the same way till it encountered the first forking of the tree, counting from the bottom, and there it had divided, and continued its course in straight lines to the ground at four different places, one on the north-east face of the trunk, and the three others on its south side. The whole course of the former blow is now distinctly marked by a long line of smooth bark, rounded and somewhat prominent; so as to present much the appearance of the stem of a great woody

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parasite deeply sunk in the tree. The whole course on the other branch is similarly indicated on the branch itself and on three places of the trunk; but on the north-east face of the trunk there is simply a deep narrow crack in the bark, without any attempt at restoration. The blow on the second branch, in its descent, had both destroyed a considerable branch at the forking of the tree, and torn off bark and wood from the trunk above the fook; and here the wood is still extensively bare, widely exposed to the air, yet nevertheless very little advanced in decay. Another peculiarity is that the long ribbon of bark, ten feet at least in length, which had been ripped off, had carried away with it some adhering layers of wood, and had not been detached where the stripping terminated a short way down the trunk; and that a healthy branch, thicker than one's wrist, terminating in twigs and foliage in the usual way, has been formed in a peculiar manner on the inside of the ribbon of detached bark. The tree looks healthy and vigorous in spite of the rough usage it had received. But it incurs eventual risk from the gash made in its wood immediately above its first division into branches.

The third kind of injury is admirably exemplified in the ash-tree at the Dean toll-bar. The lightning appears to have struck its west side, about twenty-five feet from the ground, close to the second and principal branching of the trunk. It had there torn down a small branch, the seat of which is marked by a scar in the bare wood, extending half way to the ground. Below this point of impact the bark has been stripped off, without other visible injury to the wood, in a way which it is difficult to describe, but which I have endeavoured to represent in the accompanying rude drawings. The greatest extent of damage has been done to the west side, on which extremely little bark is left on the whole twenty-five feet of trunk. On the other sides the stripping, though also very great, is less and irregular. Altogether about two-thirds of the whole trunk is barkless; and the destruction goes continuously around it, so that nowhere is the perpendicular space between the upper and lower edges of the remaining bark less than four feet and a half or five feet. The bark, wherever stripped off, has

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been carried away through its entire thickness down to the very wood.

I saw the tree two days after the accident, when the amputated branch and great shreds of bark lay around it. The white glistening uncovered wood, contrasting with the dark-grey remaining bark, gave it a very extraordinary appearance, now much less remarkable since the wood itself became grey from two years of exposure to the weather. I could not at first detect any other damage than what has been just described. But now two long fissures may be noticed on the south side next the road, one through the bark above, where it has been left attached, the other hard by in the exposed wood immediately below; and at the lower end of the former, and also at the upper end of the latter, I can see too very narrow chinks of light, so that these fissures must penetrate quite through the trunk, where it is between eighteen and twenty-four inches in diameter. It is probable, therefore, that the electric fluid had in part, at its place of impact, which is very nearly on the same level with these chinks, struck right through the tree, to reach and strip off the bark on the south and east sides,—thus nearly repeating the injury inflicted some years ago close to Moredun House on a large ash; which was struck at a forking, split down the middle of the trunk, and one-half shattered into fragments, while the other half was left standing.

Injury of the kind here described is necessarily fatal. But death is by no means immediate; and the gradual waning of life becomes an object of some interest to watch.

The foliage of the stricken tree did not appear to sustain any harm during what remained of the vegetating season. Fruit even formed on it; for ash-keys hung from its twigs after the leaves fell off in October. But I neglected to ascertain whether the seeds ripened. Next spring—that is, last year—buds were produced over the whole tree, and the foliage eventually was considerable; but it was thinner than before; and at the end of autumn the twigs showed no fruit hanging from them. When vegetation commenced in the present year, the tree for some time seemed to be dead. But fourteen days after all the ash trees near it

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had begun to vegetate, its lowest branch, a small one on the east side, put forth buds, which have since thriven so well that the twigs may be said to be fully clothed. A week later buds formed also on all the branches to the south and east, but only on the terminal twigs. These buds have since made fair progress; but the resulting foliage is far inferior to that of the little branch below; and consequently as the tree is approached from town now, in the middle of July, it appears quite leafless till very near it. A week after these high branches began to bud, their example was followed by a very few twigs on the different branches which spread to the west and north; but in the subsequent week of warm dry sunny weather these buds withered and disappeared.

The present state of the tree (July 13th) is this. The torn edge of the bark connected with the ground has curled inward and adheres to the wood. The edge of the upper bark, separated from the lower by a very wide gap, nowhere shows any such change, and in some places hangs down in loose shreds. The branch a (Pl. VIII.) presents full foliage. The lower bark here approaches very close to that of the branch; but there appears to be a narrow gap or fissure between them. The branches a′ and b have a scanty foliage on their terminal twigs. The branches A and B are leafless. The leafless branches are all to the west of the fissures in the trunk D, and on that side of the tree which the lightning first struck.

P.S.—Aug. 19.—The entire vegetation, described above as it was on July 13, is now completely withered and dried, even the vigorous shoots on the lowest little branch (a). Everywhere else, indeed, the withered leaves have even dropped off, on that branch they still hang attached, but quite dead and dried. The last ten days of continuous heat, drought, and sunshine may have contributed to this universal death.

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II. *Notes on the Synonymy of certain Species of Abies.* By W. R. M'Nab, M.D., Edinburgh, Professor of Botany, Royal College of Science for Ireland, Dublin.

During the last twelve months I have had occasion to examine the microscopic structure of the leaves of most of the species of Abies, and as the characters derived from the study of the anatomy of the leaf are, when taken in conjunction with others, of great value, I propose to say a few words on some of the results obtained. Through the kindness of numerous friends, I have been enabled to examine nearly all the known forms; and of those mentioned by Parlatore in "Decandolle's Prodromus," I have only failed to obtain two, viz., *A. homolepis*, Sieb. and Zucc., which, according to Parlatore and others, is the same as *A. firma;* and *A. holophylla*, from Mandchuria. I am chiefly indebted to Dr Hooker, Professor Oliver, Professor Balfour, Professor Perceval Wright, Dr Moore of Glasnevin, Mr Fowler of Castle Kennedy, Mr Syme of Elvaston Nurseries, Mr Anthony Waterer, Knaphill Nurseries, Messrs Veitch of Chelsea, and my father, for most liberal supplies of material, both living and in a dried state.

Parlatore enumerates eighteen species in the Prodromus. These are, 88. *A. bracteata;* 89. *A. nobilis;* 90. *A. Fraseri;* 91. *A. religiosa;* 92. *A. pectinata* (*Abies*, Du Roi, Parl.); 93. *A. cilicica;* 94. *A. Pinsapo;* 95. *A. balsamea;* 96. *A. firma;* 97. *A. holophylla;* 98. *A. brachyphylla*; 99. *A. Pindrow;* 100. *A. Webbiana;* 101. *A. sibirica;* 102. *A. amabilis;* 103. *A. concolor;* 104. *A. grandis;* 105. *A. Veitchii* (*selenolepis*, Parl.)

As synonyms of No. 102. *A. amabilis*, Parlatore gives *A. lasiocarpa*, Hooker; *A. bifolia*, A. Murray; and *A. magnifica*, A. Murray. From an examination of many forms, I conclude that *amabilis*, Parlatore, is not *amabilis*, Douglas; that *A. lasiocarpa*, Hooker, is a distinct form, and that *magnifica* is also entitled to specific rank. The synonymy is exceedingly complicated; but by the careful examination of the foliage and cones, as well as by an examination of the structure of the leaf, many difficulties can be cleared up.

A. amabilis, Douglas, and also of our gardens and nurseries, is distinguished by the peculiar arrangement of its

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leaves, which thickly cover the upper sides of the shoots, and are much twisted at the base. The leaf has no stomata on the upper side, two bands on each side of the midrib below; the apex is obtuse and emarginate. On transverse section the leaf shows a large development of hypoderma, with the resin canal close to the epidermis of the under side. The bract is large, but concealed by the scale, and is ovate and acuminate.

I have examined a number of specimens of this form. It is cultivated in the Royal Botanic Garden, Edinburgh, under the name of *amabilis*. I have received it under the name of *amabilis* from Mr Syme and Mr Waterer; and leaves from a fine plant, growing near Ambleside, were given to me by Dr Moore. It is *A. spectabilis* of Herp. de Fremont and Bertrand; the *lasiocarpa* of Balfour; Jeffrey's No. 409. It is *A. grandis* of Lambert and Mr Andrew Murray in his Synonymy of various Conifers. I have also seen three specimens in Kew Herbarium from the Oregon Boundary Commissioners, named doubtfully as *nobilis*, *balsamea*, and *grandis*.

A. amabilis, Parlatore, not Douglas, includes two other forms. The first is *A. lasiocarpa*, Hooker, which is really the *amabilis* of Parlatore, excluding the synonyms, and is best known as *A. bifolia* of A. Murray. The species is bifolious, with two forms of leaves. The resin canals are in the parenchyma of the leaf, and the bract is very small, with a long tooth. I have only met with very young seedling plants in cultivation, sent to me by Mr Syme of Elvaston. It is the *P. lasiocarpa*, Hook., in Kew Herb., collected by Douglas; leaves of the type specimen having been sent to me by Professor Oliver. There is also an unnamed specimen in Kew Herb., collected by Douglas, from the Hort. Soc., London. There are also five specimens in Kew Herb. from the Oregon Boundary Commissioners, the type of Mr Andrew Murray's species, with the native Indian name "Marielp." I have received leaves from Mr Syme of specimens sent by M. Roezl. It was also sent by Jeffrey, and there are two cones in the Edinburgh Museum, marked *Picea magnifica robusta.*—Jeffrey, 1480; Oregon, 1853.

The next form confused by Parlatore with *amabilis* is *A. magnifica*, A. Murray. It comes next in anatomical

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structure to *A. nobilis*, having a single and not a double fibro-vascular bundle. The bract is very like that of *amabilis* at first sight; but the anatomy of the leaf is very different. It is cultivated by Mr Syme, Mr Waterer, and in the Royal Botanic Garden, Edinburgh, under the name of *magnifica*. My father has also sent it to me as *P. robusta*. It is in Glasnevin Garden as *P. amabilis*, from Perth Nurseries. There are cones in the Museum of the Royal Botanic Garden, Edinburgh, named *P. robusta magnifica*, 1480, and *P. magnifica robusta*, 1480, so that under 1480, Jeffrey, both *lasiocarpa*, Hook., and *magnifica*, A. Murray, have been confounded. There is also a specimen from P. Lawson and Son. There are three specimens in Kew Herbarium, one from Lobb, the original specimen of Mr Murray's description, and two from Mr Low of Clapton, to whom Lobb's specimens and seeds were transmitted.

As synonyms of No. 104, *A. grandis*, Parlatore gives *A. Lowiana*, Gordon, and *A. lasiocarpa*, Balfour; *grandis* of Douglas and gardens; *amabilis* of Mr Andrew Murray. The scale is jagged and two-lobed, with a central tooth. The leaf has the resin-canals close to the epidermis of the lower side, and the hypoderm consists of a few scattered cells. It is *A. Gordoniana* of Bertrand and Carriere. I have examined sixteen different specimens of *grandis*, all having the same characters. It is *lasiocarpa* of gardens, but not of Balfour, and also goes by the name of *amabilis*. It is Jeffrey's No. 393, sent out along with No. 409 as *lasiocarpa*.

A. Lowiana is a distinct plant anatomically, and although said to have been introduced by Mr Low of Clapton in 1862, was sent home in 1854 by Mr Jeffrey. No number is attached to the specimen in the Museum, Royal Botanic Garden, Edinburgh; so that it was possibly sent out as *lasiocarpa* or *grandis*. There is a specimen in the Museum collected by Mr William Murray in California, and presented by Mr Andrew Murray in 1860, which, although marked *grandis*, is *Lowiana*. It also passes under the name of *Parsonsii*.

Among the Japanese species, I must notice *A. bifida* and *A. firma*. Parlatore gives No. 96, *A. firma*, with *bifida* and

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homolepis as synonyms. *A. firma* of Parlatore is probably *bifida*, Sieb. and Zucc., a species readily distinguished by the resin-canals close to inferior epidermis, and having remarkable idioblasts in the parenchyma. *A. firma* of gardens is *bifida*. Parlatore gives, under No. 96, a species called *A. brachyphylla*. Having examined an authentic specimen in Kew Herbar. from Maximowicz, I find it to be the same as *A. firma*, Sieb. and Zucc. It is distinguished from *bifida* by the form of the leaf, the resin-canals in the parenchyma, and the absence of the idioblasts. *A. firma* of Parl. (exclusive of synonyms) thus equals *bifida* of Sieb. and Zucc; while *brachyphylla*, Parl. (Maxim.), equals *firma* of Sieb. and Zucc.

Some confusion also exists regarding the *Abies Veitchii*. The specimen in Kew Herbarium, as well as that described by Bertrand, is closely related to *firma*, having the resin-canals in the parenchyma of the leaf, but having no hypoderma. The species cultivated in our gardens and museums as *Veitchii* is quite distinct, the resin-canals twisting the inferior epidermis, and having the hypoderma very largely developed. As it seems to be a new form, I have provisionally named it *Abies Harryana*, after Mr Harry J. Veitch, the head of the firm in London.

The examination of the Himalayan species has led to the discovery of a third form. We have *Pindrow* and *Webbiana;* and the third, as yet unnamed, differs from the other two, in having the resin-canals in the parenchyna. A fine shoot, with a cone, is in the Edinburgh Museum. It was ripened at Castle Kennedy, and presented by Mr Fowler.

III. *Open-Air Vegetation at the Royal Botanic Garden.* By James M'Nab, Curator.

(Continued from p. 393.)

The month of *August* 1875 at Edinburgh was very agreeable. The six lowest thermometer readings were on the mornings of the 1st, 2d, 4th, 5th, 20th, and 28th, when 47°, 42°, 47°, 42°, 43°, and 45° were respectively indicated; while the six highest morning readings were on the 3d, 13th, 15th, 16th, 17th, and 22d—55°, 54°, 56°, 59°, 59°, and 58° being registered on those dates. Autumn tints began

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to show on the lime tree, sugar maple, birch, Constantinople hazel, laburnum, *Amelanchier vulgaris*, locust trees, and Siberian pea tree (*Robinia Caragana*, var. *inermis*). The trees and shrubs fruiting were the Siberian crab, red and yellow-berried mountain ash, red and black-fruited elder, hawthorns, snowberry, *Berberis vulgaris*, *Mahonia aquifolium*, *Ribes sanguineum*, *Cotoneaster microphylla*, and *Prunus lusitanica*. Many variegated and coloured-leaved trees at this season contrast well with the ordinary dark-foliaged trees, such as the variegated *Acer negundo*, the copper-coloured hazel and oak, and purple beech. The golden foliage of *Quercus concordia* was conspicuous, as well as the variegated Turkey oak and golden-leaved elder.

Plants in Bloom on the Rock-Garden in August 1875.

Aug. 1. Œnothera taraxacifolia.
„ 2. Yucca Ellacombei.
„ 3. Achillea ægyptiaca.
„ 3. Helianthemum algarviense.
„ 3. Nierenbergia rivularis.
„ 4. Adysetum argenteum.
„ 4. Chelone perfoliata.
„ 4. Potentilla splendens.
„ 5. Anemone vitifolia.
„ 5. Herniaria ciliata.
„ 5. Œnothera riparia.
„ 5. Parochetus communis.
„ 6. Potentilla davurica.
„ 6. Tonguei.
„ 6. Spraguea umbellata.
„ 8. Calluna vulgaris Foxii.
„ 10. Colchicum autumnale, pink.
„ 11. Silene chloræfolia.
„ 12. Calluna vulgaris pygmæa.
„ 12. Colchicum autumnale album.
„ 12. Gentiana affinis.
„ 13. Eriogonum compositum.
„ 14. Calluna vulgaris Hammondii.
„ 14. Cyclamen hederafolium.
Aug. 14. Sedum Eversii.
„ 14. Statice Gmelini.
„ 15. Calluna vulgaris Alporti.
„ 15. Origanum pulchrum.
„ 16. Sheffieldia repens.
„ 18. Colchicum crociflorum.
„ 18. Sedum cordifolium.
„ 18. Veronica spicata corymbosa.
„ 20. Calluna vulgaris Serlii.
„ 20. Cineraria alpina.
„ 20. Colchicum autumnale pallidum.
„ 20. Erica Tetralix alba.
„ 20. Thymus carnosus.
„ 21. Œnothera triloba.
„ 22. Dianthus Atkinsonii.
„ 22. Erica cinerea longispica.
„ 23. Colchicum speciosum.
„ 23. Erica cinerea alba.
„ 25. Gnaphalium triplinervum.
„ 26. Colchicum variegatum.
„ 26. Potentilla glabra alba.
„ 27. Sedum Sieboldii.
„ 30. Potentilla aurea.
„ 30. Thymus Mastichina vera.
„ 31. Scabiosa Fischeri.

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On 1st September 263 species and varieties were in bloom, and many flowering for the second time. The most conspicuous were *Acœna Novœ Zealandiœ*, *Androsace lanuginosa*, *Bellis rotundifolia cœrulea*, *Calluna vulgaris* of sorts, *Campanula floribunda*, *C. isophylla alba*, *C. turbinata Grievii*, *Colchicum autumnale* (pink and white), *C. speciosum*, *Cineraria alpina*, *Cyclamen hederafolium*, *Dabœcia polifolia alba*, *D. purpurea* and *D. versicolor*, *Erica ciliaris*, *E. cinerea* of sorts (the most conspicuous being *E. cinerea longispica*), *E. Lawsoniana*, *E. Mackaiana*, *E. Tetralix*, and *E. Watsoni*, *Epilobium obcordatum*, *Erodium macrodenum*, *Gaultheria procumbens*, *Gentiana asclepiadea alba*, *Linaria alpina*, *Lithospermum prostratum*, *Polygonum vaccinifolium*, *Pterocephalus Parnassii*, *Santolina Chamœcyparissus*, *Sedum cyaneum*, *Symphyandra pendula*, *Thymus striatus*, *Veronica alpestris*, and *V. spicata corymbosa*, also *Yuccas* of sorts.

September was, on an average, favourable. The weather, during the early part, was dry, but rain prevailed towards the end. The six lowest thermometer readings were on the mornings of the 1st, 11th, 12th, 23d, 29th, and 30th, when 40°, 37°, 37°, 39°, 38°, and 37° were respectively indicated; while the highest morning readings were on the 3d, 6th, 7th, 8th, 18th, and 20th, when 55°, 54°, 53°, 56°, 53°, and 56° were registered. Autumn tints appeared early this year. About the middle of the month *Pavia flava* was particularly beautiful, the foliage continuing for a considerable time of a rich golden hue, without a leaf falling. About the same time the Norway maples were very interesting, and *Betula pontica*. The sugar maple was particularly rich, covered with leaves of scarlet and yellow. The American oaks and Liquidambar were fast changing colour, as well as the trees enumerated in August. Early in September *Thuja aurea* and *elegantissima* began to assume the green colour peculiar to them in autumn; and, by the end of the month, the golden tints, characteristic of these shrubs, had totally disappeared. The blue-green tint of *Robinia Pseud-Acacia* had a singular appearance contrasted with neighbouring forest trees, whose autumnal dress inclines more to red and yellow hues. Autumnal fruit-bearing trees and shrubs were well-covered, such as the

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white beam or service tree, mountain ash, *Cotoneaster affinis* and *C. microphylla*, all the varieties of crab apples, thorns, holly, yew, elder, snowberry, and others. Of dwarf flowering shrubs, the hardy heaths, *Dabœcia polifolia* and *Fothergilla alnifolia*, were perhaps most conspicuous; few others were wholly in bloom. Of herbs, the greatest bloom during September was amongst the Compositæ, chiefly the genera Aster, Rudbeckia, Helianthus, Eupatorium, Solidago, Pyrethrum, and Coreopsis. The roots of many *Tritomas* were injured by the severe frost of last winter, while some plants were destroyed. Flower spikes of *Gynerium argenteum*, or Pampas grass, were very deficient; a deficiency general in the kingdom, resulting in some cases from injury received in winter,—in others, from drought during summer. One specimen, however, which I recently saw in Mrs Marks' garden, Rutland House, Park Road, Kingston, Surrey, had no less than 130 heads. In the rock-garden few additional plants flowered, although many were in bloom, some for a second time, and others for an unusual period, in consequence of the moisture. On the 30th ninety-five species and varieties were in bloom, the most conspicuous being—*Acœna microphylla*, *Androsace lanuginosa*, *Bellis rotundifolia*, *Calluna vulgaris Serlei*, *C. v. flore pleno*, *Campanula floribunda*, *C. isophylla alba*, *Colchicum autumnale* (double pink and double white), *Coronilla varia*, *Dabœcia polifolia alba*, and *versicolor*, *Dianthus deltoides*, *D. Henryanus*, *D. racemosus*, *Erica ciliaris*, *E. Lawsoniana*, *E. Mackaiana*, *E. Maweana*, *E. vagans*, *E. v. rubra*, *E. Watsoni*, *Erodium macrodenum*, *Gypsophila arenaria*, *Hedychium Gardnerianum*, *Hutchinsia alpina*, *Iberis Tenoreana*, *Linaria alpina*, *Lithospermum fruticosum*, *Menziesia cœrulea*, *Pentstemum heterophyllum*, *Petrocoptis Lagascœ*, *Polygonum vaccinifolium*, *Potentilla lupinoides*, *Pterocephalus Parnassi*, *Saxifraga Wilkommiana*, *Scabiosa graminifolia*, *Sedum ibericum*, *S. spurium album*, *Stenactis speciosa*, *Thymus striatus*, *Tritoma Uvaria*, *Veronica rupestris*, and *V. spicata corymbosa*.

Dates in September on which the following Plants Bloomed.

Sept. 1. Sedum Fabaria.	Sept. 2. Metrosma pilosa.
„ 1. Calluna vulgaris flore pleno.	„ 3. Sedum Sieboldii.
	„ 5. Eversii.

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Sept.	9. Gentiana Andrewsii.	Sept.	14. Colchicum, double white.
„	10. Chrysopsis villosa.	„	14. Horkelia californica.
„	11. Colchicum, double pink.	„	15. Crocus speciosus.
	12. Crocus nudiflorus.	„	18. Colchicum rubrum.
„	13. Erica hibernica stricta rubra.	„	25. Erica Maweana.

Garden Vegetation in October.

October is the month when trees exhibit the greatest variety of colouring. Some, however, as the ash, walnut, elder, &c., only assume a dingy green tint. On the 30th many still had their foliage, and in some cases quite green. Amongst these were the Oriental plane, *Alnus cordifolia*, *Quercus fastigiata*, *Sorbus vestita*, *Rhamnus catharticus*, and others with smooth leaves, which eventually fall more or less coloured. Other kinds then in leaf, with foliage more or less hairy, generally fall off in their green condition, such as *Celtis occidentalis*, the mulberry, common fig, and *Catalpa syringæfolia*. During the whole of October the tints on ornamental and forest trees have been more interesting than they have been for long. Some have shown a rich crimson or red hue, some innumerable shades of brown and yellow, while others have all the tints on the same tree, such as sugar maple, Liquidambar, and the Virginian creeper. The tulip tree, when it first fades, has its leaves equally divided between green and yellow; afterwards they all become yellow for eight or ten days, and after assuming a darkish brown hue, fall off. During October yellow tints were most prominent, particularly as *Acer monspessulanum*, *A. campestre*, *Cratægus heterophylla*, common horse chestnut, *Quercus conferta*, *Q. alba*, *Betula pontica*, *Sorbus Aria*, and other species, retain their leaves long in their coloured condition; others fall immediately the yellow tint comes on them, as in various species of lime and Wych elm. When leaves assume a dark red or deep brown hue, they generally remain longer on the trees than those with yellow tints. This was observed in the American oaks, particularly *Quercus rubra*, *Amelanchier vulgaris*, and some varieties of beech. The ordinary purple beech generally parts with its leaves early, and, when going off, the colour is scarcely discernible from the decaying

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foliage of some green beeches, particularly the thick-leaved sorts. A variety of purple-leaved beech, common in gardens at Corstorphine, comes out in spring of a greenish tint,—in summer it is rich dark purple, towards autumn again greenish, and ultimately dark brown, not unlike the green varieties, but retaining its leaves longer than the ordinary purple form. The Corstorphine plane (*Acer Pseudo-Platanus* var. *lutescens*) is known all over Europe from the yellow tint of its leaves in spring. During summer they become as green as the ordinary *Acer Pseudo-Platanus*, and in autumn no difference is observed in the falling foliage. Although no difference is observed in the leaves of *Acer Pseudo-Platanus* when they first come out, the purple tinge peculiar to the under side of the leaf becomes conspicuous during summer; and, when the leaves fall in autumn, this is distinctly visible, although the surface of the leaf has the greenish-yellow hue peculiar to the species. The silver or variegated *Acer Pseudo-Platanus* comes out in spring of a pale green colour; during early summer the variegated or white portions become distinct; and, when the leaf falls in autumn, they are clear yellow, and the green portions the colour peculiar to the species. *Cratægus oxyacantha lutescens* comes out in spring a rich yellow hue, and continues for many weeks; during summer the leaves become green, and were so on 30th. The Scotch laburnum, noticed in my July report as having the points of the top shoots of a rich golden-yellow, has now that tint nearly all over; but no leaves had fallen on 30th. A beautiful effect is produced in some years, by the fruit hanging in thick yellow-green masses long before the ripening of the seed. The foliage of *Pavia flava* and *Amelanchier vulgaris* has been remarkably fine this autumn, as they retained their coloured leaves much longer than most other trees. The former was of a rich yellow,—the latter of a deep red hue. As they are in perfection about the same time, they ought to be cultivated for producing autumn landscape effects. During August many leaflets fell from the locust trees (*Robinia Pseud-Acacia*) of a deep yellow colour, probably at a period when some changes were taking place in the juices of this tree. In September the foliage of the Robinia assumed a peculiar blue-green tint,

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changing afterwards to dark green. We hope some competent chemist will analyse the fluids contained in the leaves, and explain the various colours assumed. During a recent tour in England and Ireland I expected that, being further south, and therefore better ripened, the tints would be in advance of those here, but I was surprised to find many trees in their normal green condition, which were coloured before I left Edinburgh. This may be accounted for by the comparatively dry weather experienced at Edinburgh compared with other parts of Great Britain. Although rain frequently prevailed here, it was not sufficient to penetrate the subsoil. Nothing could exceed in richness the foliage of the Virginian creeper in many parts of England this autumn, particularly on the old buildings at Oxford. *Ampelopsis Veitchii* and *A. tricuspidata* were gorgeous in several places, but not cultivated to the extent they deserve. During the month the foliage of some shrubs has also been interesting, particularly varieties of Azalea—the *A. pontica* being most prominent, owing to the rich tints of crimson and yellow it puts on. *Fothergilla alnifolia* was of a yellow hue. *Weigelia amabilis* surpassed all others, the long pinnate leaves hanging gracefully round the plant. Each leaf is composed of ten or twelve pairs of leaflets, the uppermost pair being generally of a reddish-golden colour; as they near the middle they become beautifully shaded off to a rich yellow between the middle and the point, the yellow and green leaves become gradually mixed, while three or four pairs of leaflets nearest the points are totally green. The leaves of this shrub remain for a considerable time in their transition state; it is, therefore, worthy of more extensive cultivation, not only for its flowers, but for the autumn tints. Of fruit-bearing trees and shrubs, the most conspicuous at present are hollies, yews, *Cotoneaster microphylla*, *Euonymus europœus*, Pyracantha, thorns, and snowberry. Of flowering shrubs. *Arbutus Unedo*, Laurustinus, *Escallonia macrantha*, and *Jasminum nudiflorum* are the chief in bloom. Flowering herbaceous plants are much the same as recorded in September, the Compositæ being most numerous. On the rock garden eighty-six species and varieties are still in flower, the most attractive being the late varieties of heaths

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and Dabœcias; also *Acœna microphylla, Androsace lanuginosa, Bellis rotundifolia, Dianthus deltoides, Erodium macrodenum, Gypsophila arenaria, Hedychium Gardnerianum, Helleborus niger major, Linaria alpina, Lithospermum fruticosum, Polygonum vacciniifolium, Potentilla lupinoides, Pterocephalus Parnassi, Scabiosa gramuntia, Sedum ibericum* and *S. spurium, Thymus alpina* and *T. striatus, Tritoma Uvaria, Veronica rupestris* and *V. spicata corymbosa.* The brown tint is now distinct on the shrubs of *Thuja aurea* and *T. elegantissima.* The transition state this year has not been very rapid, but this is always very marked when the cold at this season is more intense. The six lowest morning temperatures were on the 10th, 12th, 13th, 25th, 26th, and 29th, when 30°, 26°, 29°, 31°, 31°, and 32° were registered; while the highest morning temperatures were on the 1st, 8th, 18th, 22d, 23d, and 24th, when 50°, 50°, 45°, 46°, 47°, and 45° were indicated. November set in with much rain, attended with high winds and afterwards severe frost, which denuded the trees of their leaves, and thereby deprived us of many beautiful autumnal tints.

November has been remarkable for wind, rain, frost, and snow; the excess of the two latter has been exceptional. On seventeen mornings the thermometer was at or below freezing, the lowest markings being on the 9th, 10th, 11th, 12th, 13th, and 27th, indicating 26°, 19°, 18°, 27°, 22°, and 27°; while the highest morning temperatures were on the 4th, 5th, 6th, 17th, 18th, and 19th, indicating 47°, 45°, 44°, 42°, 42°, and 43°. The united temperatures below 32° during the month amounted to 80°, being 18° more than had been registered here during any November for thirteen years. The highest number of degrees was during November 1864, when 62° of frost was recorded. The lowest was during 1872, when 17° was registered. The following table gives the aggregate of the November frosts for thirteen years:—

November 1863, . .	53°	November 1870, . .	53°
„ 1864, . .	62°	„ 1871, . .	39°
„ 1865, . .	43°	„ 1872, . .	17°
„ 1866, . .	33°	„ 1873, . .	35°
„ 1867, . .	40°	„ 1874, . .	18°
„ 1868, . .	42°	„ 1875, . .	80°
„ 1869, . .	58°		

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With few exceptions, the leaves remaining on the deciduous trees have fallen off this month. On 30th leaves of a yellow and green colour were still on the Medlar (*Mespilus germanica*). *Taxodium distichum* was also covered with rusty-brown leaves. *Quercus fastigiata* with light-brown leaves, *Quercus conferta* had leaves only on the points of the shoots, all pendent, but of a yellowish-brown hue; *Sorbus vestita* had scarcely lost a leaf, although all were partially decayed. This pyramidal tree presents a curious appearance at this season, covered with thick leathery foliage of a light ash colour. Unripened leaves were still on Liquidambar, *Rhamnus catharticus*, *R. Frangula*, and *Wistaria sinensis*, all of a greenish tinge.

Of flowering shrubs, ivy, *Cydonia japonica*, *Arbutus Unedo*, Laurustinus, *Escallonia macrantha*, and *Jasminum nudiflorum*, were in bloom on 30th.

Among fruit-bearing trees and shrubs were *Cotoneaster microphylla*, snowberry, Pyracantha, thorns, yew, and holly. The berries of the latter are fast disappearing. The frost during the month seems to have matured them, and rendered them more palatable as the food of birds than they generally are at this season. The fruit of the thorn and yew is also disappearing from the same cause.

On the rock garden, flowers were only seen on twenty species, the most conspicuous being *Helleborus niger grandiflora*. This variety came from gardens in Aberdeenshire, where it has long grown; it flowers much earlier than the common Christmas rose (*Helleborus niger*); the blooms are larger, and remain long in flower. It bears several flowers on one stalk, which are about ten inches in length; the leaves are more persistent, longer, and of a coriaceous texture. Besides the Hellebore, we had, on November 30, *Aster Reevesii*, *Lithospermum fruticosum*, *Veronica rupestris*, *Gentiana acaulis*, *Primula vulgaris rubra*, *Calluna vulgaris Alportii*, *C. v. Serlei*, *Erica hibernica autumnalis*, *E. Watsoni*, *E. ciliaris*, *E. Mawcana*, *E. vagans grandiflora*, and *Sternbergia* (*Amaryllis*) *lutea*. This last plant has long been cultivated in the Edinburgh garden, but rarely flowered, from the roots not being sufficiently ripened in summer. When the rock garden was constructed, a few of the higher compartments facing the south, and

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surrounded on three sides with high stones, were left vacant as unsuitable for ordinary alpine plants, which are apt to get burnt up by the sun. In these the roots of the Sternbergia were planted two years ago, and the plants are now vigorous and flower freely. This is a choice plant for late autumn cultivation, particularly in the south, where it flowers profusely. Owing to the difficulty of getting this "yellow autumn crocus," as it is called, to flower here, it has become nearly extinct in this part of Scotland.

The *December* weather was very changeable. On the 5th, snow lay to a depth of six inches; it remained a week, when it disappeared, and wind and rain prevailed till the end of the month. On twelve days only was the thermometer at or below freezing, indicating collectively 81° of frost; 75° was experienced during the first fifteen days. In December 1874 the thermometer was on twenty-eight mornings at or below freezing, indicating collectively 277° of frost; 79° during the first fifteen days, and 198° between the 15th and the end. The six lowest temperatures experienced in December 1875, were on the mornings of the 1st, 3d, 4th, 5th, 7th, and 15th, indicating respectively 22°, 25°, 25°, 22°, 24°, and 23°; while the six highest morning temperatures were on the 13th, 14th, 26th, 27th, 30th, and 31st, when 39°, 39°, 40°, 43°, 43°, and 44° were indicated.

Another table is compiled from notes on garden vegetation during 1875. It shows that 658 species and varieties of alpine and dwarf herbaceous plants flowered on the rock garden. This is considerably below the number cultivated, but gives a fair idea of the proportion of alpine species flowering each month. This list does not include a number of dwarf alpine shrubby species which do not flower regularly, nor many species which do flower, chiefly belonging to the genera Saxifraga, Sempervivum, and Sedum. These, however, count in the table at p. 516.

Table showing the Number of Species coming into Bloom each Month.

	Species.		Species.
January 1875, . .	13	July 1875, . .	73
February „ . .	18	August „ . .	49
March „ . .	55	September „ . .	15
April „ . .	123	October „ . .	3
May „ . .	162	November „ . .	1
June „ . .	140	December „ . .	6

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The above table shows a rise in the number of species flowering each month up to May, when they begin to fall off. On May 15 and 16, twenty-one species flowered, which is more than on any other two consecutive days; with ordinary border herbaceous plants the largest number generally bloom in June and July.

Besides the list of alpine plants flowering each month, as daily recorded, a list has also been kept showing the duration of blooming of many plants. In some cases certain species remained in flower one, two, or more weeks; others for two or three months successively. Five species, however, flowered for four, five, or more months together —viz., *Veronica rupestris*, *Lithospermum fruticosum*, *Androsace lanuginosa*, *Bellis rotundifolia*, and *Linaria alpina*. *Veronica rupestris* was in flower in different positions on the rock garden every month of 1875, and *Lithospermum fruticosum* since April 13. During December the following species came into bloom:—*Helleborus orientalis*, *H. albicans*, *H. niger*, *Primula denticulata*, *Andromeda floribunda*, and *Erica herbacea alba*. This last is a charming variety, having pale green leaves and pure white flowers, and blooms much earlier than *Erica herbacea* or *carnea*.

The following table gives the number of species and varieties in bloom on the rock garden on the last day of each month of 1875. The number is large in comparison with the table giving the number of species as they came into bloom each month. This is accounted for by the number of duplicates grown, particularly of good flowering species, many in positions more or less exposed to the sun, and at different elevations, where a longer duration of flowering is obtained. In this way the same species frequently appears in two or more months. The excess of August over July is chiefly accounted for by the varieties of Calluna and Erica then in bloom. In this table May exceeds all the others.

	Species.		Species.
January 30, . .	12	July 31, . .	207
February 28, . .	30	August 31, . .	263
March 31, . .	56	September 30, . .	95
April 30, . .	150	October 31, . .	86
May 31, . .	300	November 30, . .	20
June 30, . .	273	December 31, . .	13

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January 1876.—The weather at Edinburgh during January has been, upon the whole, favourable; no snow fell, although several severe snow-storms were experienced in England and in the north of Scotland. On twelve mornings only was the thermometer at or below freezing, indicating collectively 103°, the lowest being on the mornings of the 9th, 10th, 12th, 13th, 21st, and 22d, when 17°, 18°, 25°, 25°, 21°, and 17° were respectively indicated; while the highest morning temperatures were on the 5th, 6th, 20th, 24th, 27th, and 31st, when 41°, 40°, 40°, 41°, 42°, and 42° were indicated. In January 1875, the thermometer was thirteen times at or below freezing, indicating collectively 87°.

This season is rather in advance of the average, particularly as regards herbaceous vegetation and shrubby plants. The following is the order in which those early spring plants, selected twenty-six years ago, for annually recording the date of flowering, came into bloom, the same plant or plants in similar situations being selected, so as better to compare with previous and future years:—

	1876.		1875.	
Tussilago fragrans, .	January	12	January	18
Hepatica triloba, .	„	12	„	21
Corylus Avellana, .	„	14	„	15
Galanthus nivalis, .	„	16	„	18
Leucojum vernum, .	„	18	„	21
Crocus susianus, .	„	20	„	23
Rhododendron atrovirens,	„	25	February	4
Eranthis hyemalis, .	„	26	January	30
Daphne Mezereum, .	„	26	February	4
Crocus vernus, and vars.,	„	28	„	10
Galanthus plicatus, .	„	29	„	3

On the rock-garden thirty-five species and varieties were in flower on the 31st, the most conspicuous being nine species of Hellebore, Hepaticas of various colours, *Leucojum vernum*, *Crocus imperati*, *Primula denticulata*, *Erica herbacea alba*, *Daphne Mezereum* (pink and white), *Cyclamen ibericum*, and *Eranthis hyemalis*. Flowers were also seen on *Sternbergia lutea*, *Veronica rupestris*, and *Lithospermum fruticosum*. The comparatively mild weather has brought forward the leaf-buds of many shrubs, particularly roses, scarlet-flowering currants, *Cydonia japonica*, *Nuttallia*

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cerasiformis (a Californian shrub), lilacs, &c. Flowers are also on the hazel, alder, *Rhododendron atrovirens*, *Garrya elliptica*, *Cornus mascula*, *Jasminum nudiflorum*, &c. Among the herbaceous plants which show the greatest amount of growth at present, is *Elymus condensatus* (Californian Bunch Grass). The young shoots, on the 31st, averaged fully 8 inches in length; the growths on the day lily (*Hemerocallis fulva*) were 6 inches long. The buds of several trees are also observed to be swelling fast. The quantity of catkins and flowers produced on the birch and elm gives a very dark appearance to the tops of these trees. *Thuja aurea* and *T. elegantissima* have parted with the brown hue usually assumed by these shrubs in September. They are now progressing towards their summer golden tint. These transitions are taking place earlier than usual, probably owing to the brown colour not being so strong on them as in severe winters. *Cryptomeria elegans* is also parting with its beautiful reddish winter tinge, and is now half green; the same remarks apply to many other Conifers. Snowdrops are now flourishing freely on all grass lawns having a southern aspect. Only on the grass lawns in the garden can their flowering be annually depended on; when grown in borders, the roots are either destroyed by mice or dug over in preparing the ground for other plants.

February has been wintry: snow lay from the 7th till the 16th, and again from the 25th till the 27th. The thermometer was nineteen times at or below freezing, indicating collectively 113°, the lowest markings being on the mornings of the 6th, 7th, 10th, 11th, 13th, and 14th, indicating respectively 24°, 26°, 29°, 19°, 18°, and 18°; while the highest morning temperatures were on the 17th, 18th, 19th, 23d, 28th, and 29th, indicating 38°, 37°, 38°, 39°, 37°, and 38°. The six highest morning temperatures during January were 41°, 40°, 40°, 41°, 42°, and 42°. During February 1875 the thermometer was twenty-one times at or below the freezing-point, indicating collectively 75° of frost.

The snow and frost have considerably retarded vegetation. It, however, is still somewhat early. The following is a list of the spring plants annually recorded:—

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	1876.	1875.
Rhododendron Nobleanum, . . .	Feb. 10.	March 13.
Dondia Epipactis, ...	Feb. 11.	Feb. 5.
Bulbocodium vernum, . . .	Feb. 16.	Feb. 6.
Scilla præcox, ...	Feb. 16.	Jan. 23.
Nordmannia cordifolia, . . .	Feb. 16.	March 11.
Aubrietia grandiflora, . . .	Feb. 17.	Feb. 15.
Sisyrinchium grandiflorum album, .	Feb. 17.	March 6.
Sisyrinchium grandiflorum purpureum, .	Feb. 20.	March 8.
Scilla sibirica, ...	Feb. 20.	March 10.
Iberis gibraltarica, ...	Feb. 21.	Feb. 2.
Draba aizoides, ...	Feb. 21.	March 8.
Orobus vernus, ...	Feb. 23.	March 23.
Scilla bifolia vera, ...	Feb. 24.	March 7.

On the rock garden forty-eight species were counted in bloom on the 29th, the most conspicuous being the varieties of Hepatica, *Helleborus colchicus*, *H. purpurascens*, *H. purpurascens minor*, *Dondia Epipactis*, *Crocus imperati*, *Galanthus nivalis*, *G. plicatus*, *Leucojum vernum*, *Bulbocodium vernum*, *Rhododendron præcox*, *Daphne Mezereum*, *Saxifraga cordifolia ovata*, *S. oppositifolia*, *Primula denticulata*, *P. purpurea*, *Iberis gibraltarica*, and *Corydalis angustifolia*. There are also in bloom in the rock garden *Veronica rupestris* and *Lithospermum fruticosum:* the former has been in flower more or less since January 1875, and the latter since April. On the grass slopes snowdrops, *Crocus susianus*, and *Scilla bifolia* are flowering in abundance. In consequence of snow and frequent frosts the snowdrops were not in perfection till the 27th. *Crocus vernus* and its varieties, although flowering from 28th January, did not fully bloom till the end of this month. Most shrubby plants mentioned in last report as far advanced have not suffered, but they have made little progress. The yellow stone-crop is now perfectly yellow, although on January 31 the golden colour was only visible on a few pieces hanging down some stones towards the sun. No perceptible change has taken place in the buds of trees.

March has been rough, with much snow, rain, wind, and frequent frosts, which proved a great hindrance to the progress of vegetation and out-door works. On

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twenty-one mornings the thermometer was at or below freezing, indicating collectively 98°; the lowest markings being on the 13th, 16th, 17th, 19th, 20th, and 21st, indicating 23°, 25°, 24°, 25°, 23°, and 20°. The highest morning temperatures occurred on the 1st, 2d, 3d, 4th, 6th, and 30th, when 38°, 36°, 37°, 38°, 37°, and 38° were respectively indicated, all being under the morning temperatures for January. During March 1875 the thermometer was ten times at or below freezing point, indicating in all 45° of frost.

Herbaceous plants this year are rather behind an average, and those which have flowered are not in good condition, both February and March having been much against them.

List of Spring Plants.

	1876.	1875.
Scilla bifolia major,	March 2.	March 14.
Arabis albida,	March 5.	Feb. 10.
Tussilago alba,	March 8.	Feb. 15.
Mandragora officinalis,	March 12.	Feb. 28.
Iris reticulata,	March 13.	March 19.
Symphytum caucasicum,	March 15.	March 31.
Narcissus pumilus,	March 15.	March 13.
Scilla bifolia alba,	March 15.	March 17.
Tussilago nivea,	March 18.	March 6.
Muscari botryoides,	March 18.	March 26.
Corydalis solida,	March 25.	March 23.
Symplocarpus fœtidus,	March 25.	March 30.
Erythronium dens canis,	March 28.	March 21.
Ribes sanguineum,	March 30.	March 30.

In the rock garden seventy-four species were in flower on the 31st. The most conspicuous were *Iris reticulata*, *Scilla sibirica*, *S. bifolia*, *S. b. major*, *S. alba*, *Sisyrinchium grandiflorum album*, *Gagea lutea*, *Helleborus angustifolius*, *Hepatica angulosa*, the varieties of *Hepatica triloba*, and *Saxifraga oppositifolia*; *Aubrietia grandiflora*, *Primula vulgaris rubra*, *P. purpurea*, *P. denticulata*, *P. nivalis*, and *P. viscosa*; *Draba aizoides*, *Dondia Epipactis*, *Andromeda floribunda*, *Erica hibernica spicata*, *E. herbacea alba*, and *Epigœa repens*. To the end of March no perceptible difference was noticed in the arboreous vegetation. It is

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evident that many plants have suffered severely during this long and changeable winter, particularly Caryophyllaceæ and Cruciferæ.

During the last three months we have had the thermometer on fifty-two mornings at or below the freezing point, indicating altogether 314° of frost; and yet ice has not at any time been sufficiently strong for skating or curling, nor have any of the frosts been sufficiently severe to reach the small vermin in the ground, not even the slugs, which at present are very destructive.

April has been variable, with much wind, snow, and rain, except one week in the beginning, when mild weather prevailed. On six consecutive mornings, viz., from the 4th to the 9th, inclusive, the thermometer at 6 A.M. registered between 44° and 57°, the highest being on the morning of the 5th. During the month the thermometer was fourteen times at or below the freezing point, indicating collectively 69°, more than has been registered during April for many years, as seen in the table at p. 527.

The lowest temperatures indicated during the month were on the mornings of the 2d, 3d, 11th, 13th, 17th, 23d, and 30th, when 25°, 27°, 26°, 20°, 27°, 25°, and 25° were respectively registered; while the highest morning temperatures were on the 4th, 5th, 6th, 7th, 8th, and 9th, when 45°, 57°, 50°, 50°, 44°, and 44° were indicated. The cold, backward, and changeable weather has been much against vegetation, many trees being still in their winter condition; the moisture, however, at the end of the month has swelled the buds considerably. Such an excess of rain before the leaves expand generally brings a rich and full foliage, which is rarely the case when the leaves come out in very dry weather, unless in natural damp situations. Hardy spring flowers were also far behind, and many of them much injured by frost. After the mild weather in the beginning of April, followed by severe frost, the lowest marking was on the 13th, when the thermometer indicated 12° of frost. This sudden change of temperature injured many Conifers, particularly Cupressineæ, also a few species of Juniperus and Pinus. The injury to the Cupressineæ was indicated by the sudden change of colour which

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most of them assumed—the surface shoots of many of them are now destroyed, and in some cases the plants appear to be dead. A large proportion of those injured are of Eastern origin, and a few are natives of the Western hemisphere. Piceas and Abies have stood well. The following species suffered most:—

Thuja orientalis compacta.
pygmæa.
glauca.
globosa viridis.
pyramidalis.
gracilis conica.
Fortunei.
incarnata.
aurea.
elegantissima.
Cupressus sempervirens.
torulosa.
Taxodium sempervirens.
Retinospora ericoides.
leptoclada.
Juniperus tripartita.
drupacea.
chinensis.
cracovea.
Pinus insignis.
muricata.
Brutia.
densiflora.
patula.
caroliniana.
Don Pedri.

On April 30, 122 species of alpine and dwarf herbaceous plants were in flower on the rock garden, the most conspicuous being—

Andromeda fastigiata.
tetragona.
Anemone apennina.
bracteata.
Robinsoniana.
alba.
Berberis Darwinii.
Bryanthus erectus.
Coptis trifoliata.
Draba aizoides.
Epigæa repens.
Erica australis nana.
hibernica alba.
stricta.
Erythronium americanum.*
giganteum.
roseum.
Gentiana verna.
Hutchinsia alpina.
Iberis gibraltarica.
Menziesia cœrulea.
empetriformis.
Polygala Chamæbuxus.
Primula ciliata purpurata.
cortusoides.
purpurea.
scotica.
Pulsatilla bracteata.
vernalis.
Ranunculus amplexicaulis.
Rhododendron Chamæbuxus.
Rhodora canadensis.
Saxifraga, various species.
Sanguinaria canadensis.
Trillium grandiflorum.

* This plant flowers well in the stove compartments, but not in the open borders.

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The spring plants noted below complete the list of species annually recorded, to show their periods of flowering.

	1876.	1875.
Hyoscyamus physaloides, . .	April 2	March 31
Narcissus Pseudo-Narcissus, .	„ 3	April 1
Adonis vernalis, ...	„ 5	March 29
Fritillaria imperialis, . .	„ 6	April 18

May has been in general dry, with easterly wind. A few showers fell, but not of that genial nature wanted for vegetation at this season. The thermometer was seven times at or below the freezing-point, indicating collectively 26°, the lowest being on the mornings of the 2d, 3d, 4th, 7th, 9th, and 13th, when 26°, 26°, 27°, 30°, 32°, and 25° were respectively registered; whilst the highest morning temperatures were on the 21st, 22d, 27th, 28th, 29th, and 30th, when 46°, 45°, 50°, 55°, 49°, and 50° were indicated. The following table shows the amount of frost experienced in May for the last 22 years. Of these years it will be seen that 1855 showed the lowest markings.

Frost Registered during May in the Royal Botanic Garden, Edinburgh, during the last Twenty-two Years.

Years.	Number of Mornings the Thermometer was at or below the Freezing Point.	Degrees of Frost Registered during the Months of May, from 1854 to 1865.	Years.	Number of Mornings the Thermometer was at or below the Freezing Point.	Degrees of Frost Registered during the Months of May, from 1866 to 1876.
		°			°
1854 . .	2	4	1666 . .	0	0
1855 . .	9	29	1867 . .	1	2
1856 . .	2	4	1868 . .	1	6
1857 . .	2	2	1869 . .	4	13
1858 . .	3	4	1870 . .	2	6
1859 . .	1	1	1871 . .	3	5
1860 . .	2	2	1872 . .	1	4
1861 . .	4	21	1873 . .	2	6
1862 . .	2	4	1874 . .	7	16
1863 . .	0	0	1875 . .	0	0
1864 . .	0	0	1876 . .	7	26
1865 . .	1	1			

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The foliage of forest trees has come rapidly forward, in consequence of the heavy rains which fell towards the end of April, before the leaves expanded. The foliage is now well matured, except American forest and ornamental trees, which are always late of leafing, as noticed in my report for May 1875. The flowering of the ordinary ornamental trees is considerably behind an average. The common horse chestnut is now covered with bloom, but the flowers are not so rich in appearance as in former years, being somewhat dingy in colour, evidently injured by the frosty nights early in the month; the leaves, likewise, are far from perfect, being much injured by vermin. Laburnums are blooming freely, particularly those trees of the Scotch variety (*Cytisus Laburnum alpinus*), which produced no blossoms last year. Although the common white and scarlet hawthorn were partially in flower on the 31st, a full blow cannot be expected before the middle of June.

Herbaceous plants this year are in general late of blooming. Many early-flowering species have produced few or no seed-vessels, probably owing to the frost in April while the plants were in blossom. Of the *Cynoglossum officinale*, which flowered abundantly in spring, and is grown here for its fruit for class purposes, little fruit is to be found, one or two achenes of the four-lobed ovary are entire, all others being abortive. *Myrrhis odorata* and *Orobus elegans* flowered profusely, but the fruit is deficient. The crown imperial is without fruit, as well as many cowslips and oxlips, whose barrenness I also attribute to the frequency of frost in April, when the plants were in flower.

On May 31st, 382 species and varieties of dwarf alpine and herbaceous plants were in flower on the rock garden, the most conspicuous for colour and rarity being—

Achillea Clavennæ.
Andromeda fastigiata.
tetragona.
Anemone palmata.
Anthyllis erinacea.
Arenaria purpurea.
Aubrietia of sorts.
Cathcartia villosa.
Chamæbatia foliosa.
Delphinium nudicaule.
Draba tridentata.
Dryas Drummondii.
Erica australis nana.
Erinus alpinus.
albus.
hispanicus.
Erodium Richardii.
Erysimum helveticum.

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Fritillaria kamtschatcensis.
Gentiana verna.
Globularia trichosantha.
Iris cristata.
Ledum buxifolium.
thymifolium.
Lithospermum fruticosum.
Menziesia Drummondii.
Myosotis alpestris.
Trifolium alpinum.
uniflorum.
Pentstemon Menziesii.
Pernetya angustifolia.
Phlox Nelsoni.
setacea violacea.
Primula cortusoides amœna.
luteola.
Saxifraga of sorts.
Symphyandra Warnerii.
Thalictrum aquilegifolium roseum.

June has been pleasant, notwithstanding the long continuance of easterly winds. Showers, though few, have done much good. The temperature was genial; a few nights were somewhat cool, but no frost was experienced. The lowest thermometer markings were on the mornings of the 1st, 4th, 10th, 14th, 16th, and 17th, when 39°, 38°, 36°, 38°, 38°, and 36° were respectively registered; the highest morning temperatures were on the 2d, 22d, 23d, 27th, 28th, and 30th, when 58°, 52°, 52°, 65°, 62°, and 51° were indicated. Many flowering trees and shrubs have presented a rich appearance, although later than usual. The scarlet horse chestnuts were remarkably fine, as were also the single and double scarlet thorns, particularly Paul's new double scarlet, which has proved a great favourite. The flowering ash (*Fraxinus Ornus*) was in perfection on June 15, and the elder showed its first flowers on the 16th, which have since been abundant everywhere. The elder is fast becoming a nuisance, seedlings coming up, not only in wild but also in garden ground, amongst the stems of laurel, azalea, kalmia, rhododendron, &c. Conifers are flowering abundantly, particularly the genus Pinus, as *P. Jeffreyi*, *P. Balfouriana*, *P Murrayana* (true), and *P. tuberculata*, some of which are flowering for the first time. On the large *Pyrus domestica* growing in the Botanic Garden, the east half is covered with young fruit, as happened two years ago, while last year the west side only produced flowers and fruit. At present (30th June) *Cratægus heterophylla* and *C. tanacetifolia* are flowering in perfection. The foliage of all forest and ornamental trees is now complete and remarkably full, except, perhaps, that of the locust trees, liquidambar, and deciduous cypress. The Catalpa tree is still

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far behind, perhaps more than any other exotic tree. Herbaceous plants flowered last year most plentifully in May; this year in June. On the rock garden 452 species and varieties were in flower on the 30th, the most conspicuous for colour and flowering being —

Acantholimon glumaceum.
Actinella scaposa.
Asperula cynanchica.
Astragalus alpinus.
Aster alpinus albus.
Arum palestinum.
Bellis rotundifolia.
Calceolaria Kellyana.
Calochortus luteus.
Campanula pulla.
turbinata.
alba.
Carex capillaris.
frigida (Scotch).
Vahlii.
Cypripedium spectabile.
Delphinium cashmirianum.
nudicaule.
Dianthus alpinus.
neglectus.
Epilobium obcordatum.
Erinus alpinus.
hispanicus.
Eriogonum aureum.
subumbellatum.
Galax aphylla.
Gentiana ornata.
Hutchinsia alpina.
Hypericum Burseri.
Linnæa borealis (Amn.).
borealis (Scotch).
Linum campanulatum.
Lithospermum fruticosum.
Menocopsis Wallichii.
Menziesia polifolia globosa alba.
versicolor.
Myosotis alpestris.
Nierembergia rivularis.
Orchis maculata superba.
maderiensis.
Oxytropis campestris.
lacteus.
Papaver alpinum.
aurantiacum.
Pernetya angustifolia.
Potentilla sikkimensis.
Primula Parryii.
scotica.
sikkimensis.
Rhododendron ferrugineum album.
Rosa pyrenaica.
Rubus arcticus.
Saxifraga mutata.
pyramidalis.
Spraguea umbellata.
Trifolium alpinum.
uniflorum.
Vaccinium Mortenia.
Veronica Guthriana.
pinguifolia.
rupestris.
verbenacea.

In consequence of the lateness of the season, the fields of cereals in some districts of Scotland are yellow with wild mustard (*Sinapis arvensis*), a circumstance that would not have happened had the cereals been the highest, as usual at this time. If so, the mustard would have been partially smothered and few seeds matured, instead of which a full crop of mustard seed will be shed, to the injury of the fields for years to come.

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Table showing the Number of Degrees of Frost Registered during each Month, from October 1, 1854, *till April* 30, 1876.

	October.		November.		December.		January.		February.		March.		April.		Total Amount of Frost Registered during each Year from Oct. 1, 1854, till April 30, 1876.
	Number of Mornings the Thermometer was at and below the Freezing point.	Amount of Frost Registered during each Month of Oct. from 1854 to 1876.	Number of Mornings the Thermometer was at and below the Freezing point.	Amount of Frost Registered during each Month of Nov. from 1854 to 1876.	Number of Mornings the Thermometer was at and below the Freezing point.	Amount of Frost Registered during each Month of Dec. from 1854 to 1876.	Number of Mornings the Thermometer was at and below the Freezing point.	Amount of Frost Registered during each Month of Jan. from 1854 to 1876.	Number of Mornings the Thermometer was at and below the Freezing point.	Amount of Frost Registered during each Month of Feb. from 1854 to 1876.	Number of Mornings the Thermometer was at and below the Freezing point.	Amount of Frost Registered during each Month of March from 1854 to 1876.	Number of Mornings the Thermometer was at and below the Freezing point.	Amount of Frost Registered during each Month of April from 1854 to 1867.	
		°		°		°		°		°		°		°	
1854–55	5	20	7	21	8	21	16	100	22	220	22	90	11	49	521
1855–56	7	32	14	58	20	113	19	95	6	22	12	62	4	6	388
1856–57	2	8	11	63	13	101	17	72	12	20	8	36	8	22	317
1857–58	2	8	6	25	1	4	15	37	16	95	15	70	12	45	279
1858–59	4	11	16	72	8	29	9	23	4	15	5	28	13	35	213
1859–60	10	56	14	55	22	106	17	52	21	125	18	45	12	45	484
1860–61	2	5	8	30	18	337	15	167	10	36	11	22	5	6	603
1861–62	4	7	14	55	15	105	12	20	7	32	12	46	6	16	281
1862–63	3	3	22	110	2	2	15	32	11	54	5	25	7	12	238
1863–64	5	10	10	35	14	50	21	394	22	165	23	71	7	12	737
1864–65	8	36	17	62	17	75	22	104	18	98	21	52	2	2	429
1865–66	6	21	13	43	5	16	10	40	18	38	15	66	3	7	231
1866–67	7	20	13	33	9	31	22	210	5	12	20	77	1	2	385
1867–68	5	8	15	40	13	41	17	75	8	10	13	29	3	10	213
1868–69	4	10	13	42	8	22	9	37	4	6	18	57	3	8	182
1869–70	5	12	15	68	19	119	16	76	17	74	5	50	9	19	408
1870–71	2	5	20	63	17	120	28	168	9	16	11	28	9	18	408
1871–72	4	24	13	39	15	59	13	42	4	13	8	23	4	5	205
1872–73	5	12	12	17	10	54	12	63	21	123	12	25	8	8	302
1873–74	3	31	10	35	9	36	9	32	11	69	6	37	6	6	246
1874–75	3	10	10	20	27	277	14	87	21	75	6	45	7	18	532
1875–76	5	13	15	80	12	81	12	103	19	113	21	98	13	69	557
		352		1046		1799		2111		1456		1122		420	

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APPENDIX (A).

STATISTICS OF THE BOTANICAL CLASS IN THE UNIVERSITY OF EDINBURGH FOR 1874.

Number of pupils, 354; of these 308 were medical students, 6 science students, 4 pharmaceutical students, and 33 general students. Students of first year, 225; advanced students, 129. Pupils of the Class of Vegetable Histology, 51. Number of lectures and examinations, 60; practical demonstrations, 30; histological demonstrations, 20; competitive examinations, 3; excursions, 12.

The following were the excursions:—1. Gorebridge and Arniston. 2. Kinghorn and Burntisland. 3. Currie and Slateford. 4. Dirleton and North Berwick. 5. Broomlee and Dolphinton. 6. Linlithgow. 7. Beattock and Moffat. 8. Springfield and Ladybank. 9. East Linton and Tynninghame. 10. Bridge of Allan and Stirling. 11. Murthly. 12. Inverarnan, Ben Voirlich, Loch Lomond.

Number of species of Plants collected during the excursions:—Phanerogamous plants, 635; Ferns and their allies, 41; other Cryptogams, 64. Total, 740.

Number of miles travelled by railway, steamboat, and walking, 961. The number of students who attended the excursions was 228; and the number at each excursion varied from 15 to 132. Total expense of the trips, £3, 7s.

Number of students during the last three years (continued from vol. xi. p. 188):—

Date.	Medical.	General.	Total Students.
1872, . .	234	49	283
1873, . .	270	38	308
1874, . .	308	46	354

Number of students who have attended the class under Professor Balfour from 1846–1874, 6334.

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Bonn, Natural History Society
Boston (U.S.), Society of Natural History
Bremen, Natural History Society

Cambridge, University Library
Caracas, Natural History Society
Caspary, Professor, Konigsberg
Cherbourg, Natural History Society
Christiania, University Library
Copenhagen, Botanical Society

Dublin, Royal Irish Academy
Dublin, Royal Dublin Society
Dublin, Trinity College Library

Edinburgh, Advocates' Library
Edinburgh, Geological Society
Edinburgh, Government Library, Royal Botanic Garden
Edinburgh, Royal Society
Edinburgh, Royal Medical Society
Edinburgh, Royal Physical Society
Edinburgh, Royal Scottish Society of Arts
Edinburgh, University Library

Florence, Nuovo Giornale Botanico Italiana, (Editors)

Glasgow, Natural History Society
Glasgow, Philosophical Society

Königsberg, Physico-Economical Society

Lisbon, Academy of Natural Sciences
Liverpool, Literary and Philosophical Society
London, British Museum
London, Linnean Society
London, Pharmaceutical Society of Great Britain
London, Quekett Microscopical Club
London, Royal Horticultural Society
Lund, University Library
Lyons, Philosophical Society

Manchester, Literary and Philosophical Society
Montreal, Natural History Society

Newcastle, Tyneside Naturalists' Field Club
New Orleans Academy of Sciences, United States
New York, Lyceum of Natural History
Norwich, Norfolk and Norwich Naturalists' Society

Oxford, University Bodleian Library

Paris, Botanical Society of France
Perth, Perthshire Society of Natural Science
Philadelphia, Academy of Natural Sciences

Stockholm, Royal Academy of Sciences
Strasburg, University Library

Victoria (Aust.), Royal Society

Washington, Smithsonian Institution
Westphalia, Natural History Society

Copies are also sent to the British and Foreign Honorary Members of the Society.

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APPENDIX (B).

PROCEEDINGS.

Thursday, 12*th November* 1874.

The following Candidates were elected Resident Fellows:—

JOHN G. M'KENDRICK, M.D., F.R.S.E.
WILLIAM J. NORMAND, 15 Grosvenor Street.

MISCELLANEOUS NOTICES.

1. Mr Anderson-Henry sent fruits of *Tacsonia quitensis*, Hook., which had ripened in his garden at Hay Lodge, also a compote made from them.

2. Dr Cumming sent leaves of a shrub from Chili called the Boldo, which had been transmitted to him by S. Williamson, Esq. of Copley, Cheshire. The leaves are said to be an invaluable specific for affections of the liver.

3. Sir Archibald Dunbar, Duffus, near Elgin, sent several bunches of Miller's Burgundy Grapes, which had ripened this season on the open wall, without artificial heat or any protection. He also sent a Pear of the variety called *Grosse Cabasse*, produced on a west wall, and which weighed 30 ounces.

4. Mr M'Nab read a note from Mr George Jarron regarding a Beech tree, 5 feet in circumference, which was struck by lightning at Dumcrieff about twelve years ago.

5. Dr Wm. Craig reported having found plenty of *Myosotis alpestris* on Cam-chreag, Breadalbane mountains, Perthshire, in July last, and presented specimens of the plant to the University Herbarium.

Thursday, 10*th December* 1875.

The Treasurer, Mr Neill Fraser, read a report on the financial condition of the Society, which showed that the income during the past year amounted to £117, 11s. 5d., and the expenditure to £98, 10s. 9½d., being an increase of £19, 0s. 7½d. over the previous year. The report was approved of.

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The following Office-Bearers for 1874–75 were elected:—

President.

Sir ROBERT CHRISTISON, Bart., M.D., D.C.L., Professor of Materia Medica.

Vice-Presidents.

Sir WALTER ELLIOT, K.S.I., F.L.S.
Professor DICKSON, M.D., F.R.S.E.
ALEXANDER BUCHAN, M.A., F.R.S.E.
CHARLES JENNER, F.R.S.E.

Councillors.

PATRICK D. SWAN, F.R.S.E.
HUGH CLEGHORN, M.D., F.R.S.E.
ALEXANDER HUNTER, M.D.
DAVID GRIEVE, F.R.S.E.
WILLIAM GORRIE, F.R.Cal. Hort. Soc.
ISAAC ANDERSON-HENRY, F.L.S., F.R.S.E.
THOMAS A. G. BALFOUR, M.D., F.R.S.E., F.R.C.P.E.
Prof. RUTHERFORD, M.D., F.R.S.E.
W. B. BOYD of Ormiston.
WILLIAM CRAIG, M.D., C.M., F.R.C.S.E., F.R.S.E.

Honorary Secretary, . Professor BALFOUR, M.D., F.R.SS. L. & E.
Honorary Curator, . . The PROFESSOR of BOTANY.
Foreign Secretary, . . Professor MACLAGAN, M.D., F.R.S.E.
Treasurer, ... PATRICK NEILL FRASER, F.R.Cal.Hort.Soc.
Assistant Secretary, . . JOHN SADLER, F.R.P.S.

Local Secretaries.

WILLIAM CARRUTHERS, F.R.S., British Museum, London, W.C.
ALEXANDER DICKSON, M.D., Professor of Botany, Glasgow.
GEORGE DICKIE, M.D., Professor of Botany, Aberdeen.
W. R. M'NAB, M.D., Prof. of Bot. Roy. Col. Science, Dublin.
PHILIP W. MACLAGAN, M.D., Berwick.
CHARLES C. BABINGTON, Professor of Botany, Cambridge.
THOMAS SHAPTER, M.D., Exeter.
JAMES GILCHRIST, M.D., Dumfries.
WILLIAM KEDDIE, 5 India Street, Glasgow.
BENJAMIN CARRINGTON, M.D., Eccles, Manchester.
WILLIAM ALEX. STABLES, Nairn.
JOHN LOWE, M.D., King's Lynn, Norfolk.
F. BUCHANAN WHITE, M.D., Perth.
Rev. W. A. LEIGHTON, Shrewsbury, Shropshire.
J. F. ROBINSON, Frodsham, Cheshire.
JAMES HECTOR, M.D., Wellington, New Zealand.
JOHN KIRK, M.D., Zanzibar, Africa.
Baron FERDINAND VON MUELLER, M.D., Melbourne, Australia.
JOHN ANDERSON, M.D., Calcutta.
W. H. CAMPBELL, LL.D., Georgetown, Demerara.
T. W. MAWSON, M.B., C.M., Surinam.
GEORGE LAWSON, LL.D., Dalhousie College, Nova Scotia.

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The following Candidates were elected:—

1. *Foreign Honorary Fellow.*

His Imperial Majesty, The Emperor of Brazil.

2. *Resident Fellows.*

George Skelton Stephenson, 60 George Square.
David Thomson Playfair.

3. *Associate.*

Andrew Brotherston, Shedden Park Road, Kelso.

MISCELLANEOUS NOTICES.

1. Mr John Robson sent a communication regarding the growth of *Araucaria imbricata* and *Sequoia sempervirens* at Linton Park, Maidstone, and also sections of their timber, for the Museum of the Botanic Garden.

2. Mr Potts, Fettesmount, exhibited a mass of roots of the common Poplar, taken from a drain pipe, which they had completely choked up for a space of 40 feet, a growth of less than five years. Mr Greig of Glencarse recorded a case of roots of a willow choking up a 4-inch water pipe for a considerable distance within four years after the pipe had been laid.

3. Professor Millen Coughtrey of Otago presented to the Museum at the Botanic Garden three "canes" of *Calamus rudentum*, which he had received from the Rev. Dr Wilson of Bombay, who had recently found this palm growing in considerable quantity in the Bombay Presidency.

4. Mr Webster sent to the Museum cones of *Picea Webbiana*, *P. Nordmanniana*, and *Abies Morinda*, which had ripened at Verner's Bridge, Ireland.

5. Professor Balfour recorded the death of Sir William Jardine, Bart., which took place at the Isle of Wight on 21st November last. He joined the Society on 14th January 1841.

Thursday, 14th January 1875.

The following Candidates were elected Resident Fellows:—

Rev. William Turner, 17 Gayfield Square.
David Charles Davidson, L.R.C.P. and S.E., Hawthorn Villa, Wardie.

The name of the following Fellow was deleted from the Society's Roll for non-payment of subscriptions:—

Charles A. Howell, Northend Grove, Northend, Fulham, London.

George Todd Chiene, C.A., was appointed auditor, and Francis M. Caird, artist, for 1875.

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MISCELLANEOUS NOTICES.

1. Mr P. S. Robertson exhibited the contents of the crop of a common domestic fowl, which had died apparently from suffocation. On examination the crop was found to be full of *Arundo conspicua*, with which the fowl-house was littered.

2. Mr Robert Kirk exhibited a specimen of the common orange containing a double row of carpels.

3. Dr W. Craig exhibited a specimen of Jaborandi Powder from Brazil

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Thursday, 11*th February* 1875.

The following Candidate was elected a Non-Resident Fellow:—

Professor JOHN GIBSON, B.A., Provincial Normal School, Ottawa, Ontario.

MISCELLANEOUS NOTICES.

1. Professor Alex. Dickson gave a demostration of the Embryogeny of *Tropaeolum speciosum*, and illustrated his remarks by means of diagrams and microscopical specimens.

2. Mr C. W. Peach noticed the occurance of *Xanthium spinosum* on the banks of the Tweed near Melrose, where it had been doubtless introduced along with wool from Australia.

3. A letter was read from Mr James Backhouse, York, in which he stated that in 1873 he collected *Trichomanes radicans* in a new station in North Wales, and that he had met with *Ajuga pyramidalis* on the Cumberland mountains.

4. Madame de Ramsay, exhibited a series of beautifully executed Drawings of Spitzbergen plants.

Thursday, 11*th March*, 1875.

MISCELLANEOUS NOTICES.

1. Mr John Grant Thomson exhibited branches of Scots Fir, having the foliage much browned. This desease, he remarked, has spread through young plantations since August last, and many trees are affected. Mr Sadler stated that he had examined the specimens, and found traces of a fungoid growth on the leaves, but was unable to say whether this was the sole cause of the brown appearance.

2. Mr Methven, nurseryman, presented a fresh flowering specimen of *Orobanche minor*, which had come up in a pot in which a

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Pelargonium was growing. Although the Pelargonium had occupied the same pot for several years, the root-parasite had only now shown itself.

Thursday, 8th April 1875.

MISCELLANEOUS NOTICES.

1. Dr Buchanan White presented to the University Herbarium specimens of *Kobresia caricina* from Ben Laoigh in Perthshire, where he had collected them in August 1874. Mr Sadler exhibited specimens of the same plant which he had collected on Ben Lawers in August 1861, and on Craig-an-Laoigh in August 1869.

2. Sir Robert Christison called attention to a section, presented to the Museum at the Botanic Garden by Lord Shand, of an ash tree blown down at New Hailes in a recent storm. There were 164 rings in the wood 9 feet from the ground, so that the tree was probably about 170 years old. It was only 8 feet 3 inches in circumference, and in its later years it had grown very slowly, as was the case with old trees generally, the outer rings being very thin indeed. The last thirty rings were very narrow, the last sixteen particularly so, and they got thin abruptly, as if the tree had ceased to grow freely at a definite period. He had also noticed in a fine larch cut down on Loch Goil, that the last fifteen rings showed a cessation of growth. Could this, he asked, have any connection with the year 1860, when so many trees were killed?

3. Mr Alexander Craig-Christie exhibited a series of mechanical Diagrams to illustrate the different forms of leaves.

Thursday, 13th May 1875.

MISCELLANEOUS NOTICES.

1. Professor Balfour exhibited specimens of a substance which had been lately presented to the Museum at the Royal Botanic Garden, procured from two species of sea-weed (*Plocaria candida* and *Gelidium corneum*) in China and Japan. It is used as food in place of isinglass. Payen notices it in the "Repertoire de Pharmacie," under the name Gelose, and makes the following remarks:—*Gelidium corneum*, treated successively without heat, by dilute acetic and dydrochloric acids, water, weak solution of ammonia, and then with abundant washing, lost 53 per cent. of its weight by the dissolving of calcareous incrustations, salts, colouring matter, and other organic substances, not being *Gelose*. This gelose is found contained in the remaining tissue. It is extracted by boiling in water without the breaking up of the tissue. The solution

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decanted boiling hot becomes a diaphanous jelly upon cooling. It may be repeatedly liquefied at the temperature of boiling water, and will be found each time to gelatinise on cooling. This jelly, when dried, is identical with the principle extracted from the commercial product brought from China.

2. Professor Balfour called attention to specimens of a farinaceous-looking substance presented to the Museum by Sir Robert Christison, and which had been sent from Jamaica by the late Dr Gilbert M'Nab, accompanied by the following title :—"Powder from the Interior of the spathe of *Areca oleracea*, or Mountain Cabbage Palm of Jamaica; each spathe yields a quart of it." Under the microscope it is shown to consist of aggregations of cells of an oblong form. They are very mobile, easily separated, and contain no starch.

3. Professor Balfour read a note from Professor Williamson regarding the structure of some fossil stems. Professor Williamson says :—"I have now got a magnificent Calamite, absolutely arborescent, with a woody zone two inches thick, and a bark which is at least of the same thickness. The entire organism is so complete as to put the notion, held by some, of the vascular zone being cortical sclerenchyma out of the question. The exogenous growth in Calamite is no isolated phenomenon, but runs through nearly all the carboniferous plants except the ferns, and it everywhere presents the same essential features of growth by external additions, and of radiating vascular laminæ separated by medullary rays."

4. Dr William Craig exhibited and presented to the Museum at the Botanic Garden some large dried specimens of the Brazilian plant which yields the drug Jaborandi, and made some remarks regarding the action of the drug.

5. Mr A. Craig-Christie exhibited a collection of upwards of sixty different kinds of seeds and fruits which he had picked out of a cargo of beans landed at Glasgow from Alexandria. He remarked that it was in this way that so many Eastern plants had been introduced into Britain.

6. Mr C. W. Peach exhibited and presented specimens of *Pecopteris polypodioides* (A. Brong.), found by J. W. Bodger in the marly oolite at Colleyweston, near Stamford. The specimens showed fructification, a rare occurrence in fossil ferns.

Thursday, 10*th June* 1875.

The following Candidates were elected Resident Fellows:—

PHILIP BURNETT GIBB, M.A., Picardy Place.
Rev. GEORGE ALISON, Kilbarchan, Paisley.

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Thursday, 8th July 1875.

The following Candidates were elected Resident Fellows:—

CHARLES PEARSON, C.A., 128 George Street.
Rev. JOHN CLARK, Abernethy, Perthshire.
JAMES COWPER, 1 Valleyfield Street.
AGORNÁTH CHATTOPÁDHYÁY, B.Sc.

MISCELLANEOUS NOTICES.

1. Dr Alex. Hunter gave a lecture on Indian Woods and Gum Resins, with their applications to useful, ornamental, and decorative purposes. Specimens of many of the woods and gum resins referred to were exhibited along with some beautiful pieces of wood carvings.

2. Mr Alex. Craig-Christie exhibited and described an ingenious apparatus for the preparation of Sea-weeds and other aquatic plants.

3. Mr Wm. Badger exhibited Drawings of a large fossil tree at Kinneil, which was taken from a fire-clay bed near Linlithgow sixteen years ago. The stem is 2½ feet high, and measures 13 feet 8 inches in circumference at the base, and 11 feet 2 inches at the top. There are two large roots attached to the stem, each measuring about 2 feet in length.

4. Mr C. W. Peach recorded his discovery of *Schizopteris adnascens* of Lindley and Hutton, in Grange Quarry, Burntisland, in May last, and exhibited drawings of the plant.

5. Mr J. Sadler exhibited specimens of *Rosa subglobosa* and *R. dumalis*, which he had lately collected near Broughty Ferry. He also exhibited specimens of *Rosa involuta* collected by Mr Gorrie on the road-side between Melville Hall and Belford Burn.

6. Mr Anderson Henry exhibited flowering plants of *Androsace sarmentosa* and a species of *Delphinium cashmirianum*, raised from seed collected by Dr Bellew at 11,300 feet above the sea in Thibet.

7. Mr F. R. Smith, Perth, exhibited some specimens of a new process of nature printing, by which the characters of the plants operated on were distinctly delineated.

8. Rev. David Landsborough sent a specimen of *Chrysanthemum Leucanthemum* in which the florets forming the ray of the capitulum were all tubular.

9. Mr Peach exhibited specimens of *Leontodon Taraxacum* having double heads of flowers, and called attention to the frequency of this condition of the plant in the neighbourhood of Melrose.

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STATISTICS OF THE BOTANICAL CLASS FOR 1875.

Number of pupils, 343; of these 289 were medical students, 12 science students, 6 pharmaceutical students, and 36 general students. Students of first year, 214; Advanced students, 129.

Pupils of the Class of Vegetable Histology, 65.

Number of Lectures and Examinations, 60; Practical Demonstrations, 30; Histological Demonstrations, 20; Competitive Examinations, 3; Excursions, 9.

The following were the Excursions:—1. Roslin and Polton; 2. Burntisland and Aberdour; 3. Longniddry and Prestonpans; 4. Currie and Colinton; 5. Balerno and the Pentlands; 6. Perth; 7. Broughty Ferry and Barry; 8 Leslie and Lomond Hills; 9. Killin and the Breadalbane Mountains.

Number of Species of Plants collected during the Excursions:—Phanerogamous Plants, 530; Ferns and their Allies, 38; other Cryptogams, 60. Total, 628.

Number of miles travelled by railway, steamboat, and walking, 600. The number of Students who attended the Excursions was 240; and the number at each Excursion varied from 32 to 135. Total expense of the trips, £2, 10s.

Number of Specimens of Plants Used.

Specimens given to Students at Class-Room Door, .	52,434
,, used at Competitive Examinations, .	6,600
,, for Class Demonstrations, . . .	7,500
,, Students' Private Examinations, . .	3,200
,, for Lecture Illustrations, . . .	3,800
,, used in Histology Class-Room, . .	1,920
	75,454
Pot Plants placed on Class-Room Table, . .	2,250
Total, . .	77,704

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DONATIONS TO THE LIBRARY, HERBARIUM, AND MUSEUM AT THE ROYAL BOTANIC GARDEN.

I. Library.

Authors.

Bomfim (Dr). Elementos de Anatomia, Physiologia e Morphologia Vegetal. Fasc. 1, 2. 8vo.—*From the Author.*

Buchenau (Dr Fr.). Index criticus Butomacearum, Alismacearum, Juncaginacearumque. 1868. 8vo.—*From the Author.*

Bulliard P. Herbier de la France. 8 vols.—*From Dr R. Dickson.*

Carrington (Dr B.). British Hepaticæ. Part 3. Royal 8vo.—*From the Author.*

Christison (Sir Robert, Bart.). Annual Address to the Botanical Society of Edinburgh. 8vo.—*From the Author.*

Cleghorn (Dr H.). Address to the Scottish Arboricultural Society. 8vo.—*From the Author.*

De Candolle (Alph.). Sur la Methode des Sommes de Temperature appliquée aux Phénoménes de Vegetation. 8vo.—*From the Author.*

——— Théorie Élémentaire de la Botanique.

——— Organographie Végétale. 2 vols.

——— Physiologie Végétale.

——— Systema Naturale. 2 vols.

——— Prodromus. Vols. I. to VIII.

——— Propriétés Médicales des Plantes. Bound up with Durbach's Arzneikräfte der Pflanzen.—*From Dr R. Dickson.*

Delpino (Frederico). Ulteriori osservazioni sulla Dicogamia nel Regno Vegetale. 1875. 8vo.—*From the Author.*

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Flower (T. B.). Flora of Wiltshire. 8vo.—*From the Author.*

Griesbach (A.). Plantæ Lorentzianæ. 1874. 4to.—*From the Author.*

Hart (H. C.). A List of Plants found in the Island of Aran, Galway Bay. 1875. 8vo.—*From the Author.*

Hayden (F. V.). Catalogue of the Publications of the United States Geological Survey of the Territories for 1874. 8vo.—*From the Author.*

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Schweinfurth (Dr G.). Discours prononcé au Caire a la Séance d'inauguration, Société Khédiviale de Géographie Alexandrie. 1875. 8vo.—*From the Author.*

Stewart (Dr J. S.). List of the Principal Trees and Shrubs of N. India.—*From Dr Cleghorn.*

Treviranus. Handbuch der Botanik. 2 vols.—*From Dr R. Dickson.*

Transactions and Proceedings of Learned Societies.

Alexandria.—Status de la Société Khediviale de Geographie. 1875. 8vo.—*From the Society.*

Belfast.—Annual Report of the Belfast Naturalists' Field Club. 1873–74. 8vo.—*From the Club.*

Guide to Belfast and Adjacent Countles. By Members of the Belfast Naturalists' Field Club. 8vo.—*From the Club.*

Berlin.—Mittherlungen aus dem Naturwissenschaftlichen Vereine. 1869–72.—*From the Society.*

Verhandlungen des Botanischen Vereins der Provinz Brandenburg. Nos. 14, 15, 16. 1872–4. 8vo.—*From A. Treichel.*

Berne.—Mittheilungen der Naturforschenden Gesellschaft in Berne. Nos. 812–827.—*From the Society.*

Bonn.—Verhandlungen des Naturhistorischen Vereins der Preussischen Rheinlande und Westphalans. 1873–74. 8vo.—*From the Society.*

Boston.—Proceedings of the Society of Natural History. Vol. XV.; Vol. XVI. Parts 3 and 4; Vol. XVII. Parts 1 and 2. 8vo.—*From the Society.*

Memorial Meeting of the Society of Natural History. 8vo. 1874.—*From the Society.*

Memoirs of the Society of Natural History. Vol. II. Part 2; Part 3, Nos. 3 to 5; Part 6, No. 1. 4to.—*From the Society.*

Bremen.—Abhandlungen herausgegeben vom Naturwissenschaftlichen Vereine. IV. Bd. 2 Heft; IV. Bd. 3 Heft, 1874–75. 8vo.—*From the Editor.*

Bristol.—Proceedings of the Bristol Naturalists' Society, 1874. 8vo.—*From the Society.*

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Calcutta.—Report of the Administration of Forest Department in the Provinces under the Government of India. B. H. Baden-Powell. Vol. I. and II. Fol.—*From Dr Cleghorn.*

California.—Proceedings of the Academy of Natural Science. Vol. V. Pt. 1. 8vo.—*From the Academy.*

Connecticut.—Transactions of the Academy of Arts and Sciences. Vol. II. Pt. 2.—*From the Academy.*

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Beretning om Universitetets Botaniske Have for Aarene. 1871–73. Af Joh Lange.—*From J. Lange.*

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Glasgow.—Proceedings of the Natural History Society. Vol. II. Part 1. 1875. 8vo.—*From the Society.*

Proceedings of the Philosophical Society. Vol. IX. No 1. 8vo.—*From the Society.*

Liverpool.—Proceedings of the Literary and Philosophical Society. No. 28. 8vo.—*From the Society.*

London.—Journal of the Quekett Microscopical Club. Nos. 27, 28, and 29. Tenth Report of the same. 8vo.—*From the Club.*

Journal of the Royal Horticultural Society. Vol. IV. Pt. 15. 8vo.—*From the Society.*

Pharmaceutical Journal and Transactions for 1874–75. 8vo.—*From the Pharmaceutical Society.*

Manual and Instructions for the Arctic Expedition. 1875. 8vo.—*From the Lords Commissioners of the Admiralty.*

The Journal of the Linnean Society (Botany). Vol. XIII. Nos. 69 to 72; Vol. XVI. Nos. 73 to 80. 8vo.—*From the Society.*

Reports of the Botanical Locality Record Club for 1873 and 1874. 8vo.—*From the Club.*

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London.—Report of the Curators of the Botanical Exchange Club for 1872–74.—*From the Club.*

Luxembourg.—Recueil des memoires et des travaux publies, par la Soc. de Bot. du Grand-Duché de Luxembourg. No. 1. 1874.—*From the Society.*

Manchester.—Proceedings of the Literary and Philosophical Society. 1873–74. 8vo.—*From the Society.*

Melbourne.—Transactions and Proceedings of the Royal Society of Victoria. Vol. XI. 8vo. *From the Society.*

New York.—Annals of the Lyceum of Natural History. Vol. X. Nos. 8–11. Proceedings, Vol. I. p. 237 to 300.—*From the Lyceum.*

Norwich.—Transactions of the Norfolk and Norwich Naturalists' Society from 1869–1875. 8vo.—*From the Society.*

Paris.—Bulletin de la Société Botanique de France. Tome XXII. Nos. 1, 2. 8vo.—*From the Society.*

Perth.—The Scottish Naturalist. Vol. III. Nos. 16, 17, 18, and 19. 8vo.—*From the Perthshire Society of Natural Science.*

Philadelphia.—Proceedings of the Academy of Natural Sciences. Parts 1–3. 8vo.—*From the Academy.*

Victoria (Australia).—Patents and Patentees. Vol. VII. 4to. —*From the Registrar-General.*

Transactions and Proceedings of the Royal Society. Vol. X. 8vo.—*From the Society.*

Washington.—Report of the Smithsonian Institution for 1872. 8vo.—*From the Institution.*

Geographical and Geological Surveys West of the Mississippi under the Direction of F. V. Hayden, United States Geologist. 8vo.—*From the Survey.*

Monthly Reports of the Departments of Agriculture for 1873–74. 8vo.—*From the Commissioner of Agriculture.*

Report of the Commissioner of Agriculture for the year 1873. 8vo.—*From the Commissioner.*

Bulletins 1, 2, and 3 of the United States Geological and Geographical Survey of the U.S. Territories. 8vo.—*From the Survey.*

Synopsis of the Flora of Colorado. 8vo.—*From the U.S. Survey.*

Annual Report of the United States Geological Survey of the Territories, Embracing Colorado; being a Report of the Progress of the Exploration for the year 1873. 8vo. —*From F. V. Hayden, U.S. Geologist.*

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II. Herbarium.

Balfour, Professor. Scottish Alpine Plants.

Bennet, D. George. A large Collection of North American Plants.

Cooke, Dr M. C. Specimens and Drawings of Fungi.

Craig, Dr W. Specimens of Jaborandi Plant from Brazil, and of *Myosotis alpestris* from Cam-Chreag, Perthshire.

Green, A. John. Parcel of New Zealand Ferns.

Macmillan, Rev. Hugh, LL.D. Specimens of Rare Lichens from Glencroe.

Peach, C. W. Specimens of *Scilla verna*.

White, Dr Buchanan. Specimens of *Kobresia caricina*.

III. Museum.

Anderson-Henry, Isaac. Fruit of *Tacsonia quitensis* ripened at Hay Lodge, Trinity.

Campbell, Mrs George, Edinample. Fruit of *Sterculia heterophylla*.

Campbell, James, Otago. Thirteen Specimens of New Zealand Native Woods.

Christison, Sir Robert. Section of *Pinus Tæda*, the Pitch Pine of Canada.

Coughtrey, Professor Millen, Otago. "Canes" of *Calamus rudentum*.

Cumming, Dr. Leaves of Boldo Shrub.

Dunn, M., the Palace Gardens, Dalkeith. Crops and their Contents taken from Capercailzie.

Duthie, J. F. Chestnut Meal-Cakes from Italy, and Specimen of *Cynomorium coccinium* from the Island of Goza.

Glendinning, Peter. Sections of the Trunks of three Large Trees blown down in Dalmeny Park.

Greig, Thomas, of Glencarse. Roots of Willow Trees taken from Drains.

Lefevre, Geo. H. Specimens of Fungi from Australia.

More, Dr James, Rothwell, Northampton. Chara encrusted with Carbonate of Lime, and Specimen of Stigmaria.

Naismyth, Sir John. Section of *Pinus austriaca*, grown at Stobo.

Peach, C. W. Specimen of *Pecopteris polypodioides*.

Pendleburg, W., Hatford. Pods of *Poinciana regia*.

Robson, John. Sections of Stems of *Araucaria imbricata* and *Sequoia sempervirens*.

Shand, Lord. Section of Trunk of Ash Tree, 8 feet 3 inches in circumference.

Thomson, John Grant, wood manager, Granton. Large Section of a Natural Scots Fir grown in Strathspey.

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Webster, J. B. Cones of *Picea Webbiana, P. Nordmanniana*, and *Abies Morinda.*

White, Dr P. Photograph of a Monstrosity in the Common Cabbage.

Williamson, Hugh, 3 Heriot Mount, Edinburgh. Cluster of *Pinus austriaca* containing 42 cones, being the terminal shoot of a tree, 25 feet in height, grown at Kenmure Castle, Kirkcudbrightshire.

Wilson, A. Stephen. Specimen of Hybrid between Wheat and Rye.

Wilson, Professor. Roots taken from a Drain which had been choked by them; also Branches of Beech showing natural grafting.

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APPENDIX.

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Patron:
HER MOST GRACIOUS MAJESTY THE QUEEN.

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Thomson, Spencer, M.D., Ashton, Torquay
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*Townsend, F., Shedfield Lodge, Fareham
*Traill, W., of Woodwick, M.D., St Andrews
Trevelyan, Sir Walter C., Bart., M.A., F.R.S.E., Wallington, by Morpeth
Tyacke, N., M.D., Westgate, Chichester
Vacy, Charles Kingford, M.D., Cornwall
Valentine, Colin S., Surgeon, Jeypore, Rajputana, India
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Vigor, A., Stonehouse, Cambridge
Waddell, Thomas, Cumbernauld
Walker, David, M.A., Colchester
Walker, V. E., Arno's Grove, Southgate, Middlesex
Wallich, George Charles, M.D., F.L.S. 11 Earl's Terrace, Kensington, London, W.
Watson, Hewett Cottrell, F.L.S., Thames-Ditton, Surrey
White, Alfred, F.L.S., West Drayton
*White, F. B. W., M.D., Perth
White, Frank Isa, M.D., Perth
White, Peter, L.R.C.S.E., Rothesay
Wilkinson, M. A. Eason, M.D., 25 Gore Street, Manchester
Wilks, G. A. F., M.D., Woodburn, Torquay
Wilson, A. Stephen, North Kinmundy, Summerhill, Aberdeen
Wright, R. Ramsay, M.A., B.Sc., Professor of Botany and Nat. Hist., Toronto
*Yellowlees, David, M.D., County Asylum Bridgend, Glamorganshire
Young, Edward, Neath, South Wales
Young, Emanuel, North Shields

LADY ASSOCIATES.

Mrs Alexander, 7 Rosebery Crescent, Edin.
*Mrs Bain, Hillside, Montrose
The Most Hon. the Marchioness Cornwallis
Mrs Scrymsoure Fothringham, Fothringham House, Forfarshire
Miss Gage, Isle of Rathlin, Ballycastle
*Miss Frances Hope, Wardie Lodge, Edin.
Lady Kane, Wickham, Dundrum, Dublin
The Hon. Louisa Anne Neville, Audley End, Essex
Mrs Michael Percival
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R. W. Arderne, Wynberg, Cape of Good Hope
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F. Marius Barneoud, Advocate, Toulon
F. Graf von Berchtold, Prague
H. A. Bolander, Botanist to the Geological Survey of California
Dietrich Brandis, Ph.D., Inspector-General of Forests, Calcutta
Henry Hunter Calvert, British Vice-Consul, Alexandria, Egypt
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Baron de Castello de Paiva, M.D. (Paris), Professor of Botany, Lisbon
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Frederick Adolphus Dietl, Vienna
P. Duchartre, Professor of Botany to the Faculty of Sciences, Paris
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F. Glocker, Brazil
Ch. H. Godet, Neufchatel, Switzerland
Dr Gottsche, Altona, Hamburg
30 G. C. Grech-Delicata, M.D., Prof. Nat. Hist. and Bot., Malta
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Dr Johannes Hanstein, Professor of Botany, Bonn
35 Theodor Helm, M.D., Vienna
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40 Louis von Houtte, Director of the Horticultural Garden, Ghent
Thilo Irmisch, Professor in Sondershausen
Edelstan Jardin, Cherbourg
Dr Karl Jessen, Professor of Botany, University of Greifswald
H. Jewett, M.D., Drayton, Ohio, United States
45 Auguste le Jolis, Cherbourg
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C. B. Lehmann, Offenbach
Rev. Louis Leresche, St Cierge, sur Moudon, Switzerland
Wilhelm Ley, Military Apothecary, Juliers
55 Dr S. O. Lindberg, Professor of Botany, Helsingfors, Finland
Daniel Jerome Macgowan, M.D., Ningpo, China
Giuseppe Meneghini, M.D., Professor of Geology in the University, Pisa
A. Millardet, Professor of Botany to the Faculty, Nancy, France
Dr Molkemboer, Leyden
60 Mostapha Mostapha, M.D., Egypt
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William Murray, San Francisco
C. Naudin, Member of the Institute of France, Collioure, Pyrenees
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L. Rabenhorst, Professor in Dresden
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G. Reichenbach, jun., Prof. of Bot., Hamburg
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75 Dr Edouard Rostan, Vallée de Pérouse, Piedmont
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C. R. Schumann of Golzen, Apothecary, Lower Lusatia, Prussia
C. Sinz, M.D., Naples
Otto Wilhelm Sonder, Ph.D., Hamburg
Dr E Strasburger, Professor of Botany, Jena
85 W. F. R. Suringar, Professor of Botany, and Director of the Botanic Garden, Leyden
Mahomed Ali Soubki, M.D., Egypt
Armand Thielens, D.N.Sc., Tirlemont
G. H. K. Thwaites, Ph.D., F.R.S., Director of the Royal Botanic Garden, Peradenia, Ceylon
Roberto de Visiani, Professor of Botany, Padua
90 Hugh Algernon Weddell, M.D., Poitiers
93 Maurice Wilkomm, Professor of Botany and Director of the Botanic Garden, Dorpat.

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ASSOCIATES.

Bell, William, Markham Grant, Dehra Doon North-West Provinces, India
Boyle, David, Boxhill Post-Office, Nunwading, South Bourk, Melbourne
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Howie, Charles, Eden Cottage, Largo
Jaffray, Andrew, Darjeeling
Kerr, Andrew, Taxidermist, Montrose
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Scrymgeour, James, 8 Victoria Square, Dundee
Scott, John, Patna, Bankipore, Bengal
Shaw, William, Gunsgreen, Eyemouth
Sim, John, 9 Commercial Street, Perth
Stewart, Neil, 11 West Richmond Street
White, Adam, Tower Street, Portobello

Societies and Universities to which the Society's Transactions are sent.

Alloa, Society of Natural Science and Archæology

Belfast Naturalists' Field Club
Berlin, the Botanical Society
Bonn, Natural History Society
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Bremen, Natural History Society

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Caracas, Natural History Society
Caspary, Professor, Konigsberg
Cherbourg, Natural History Society
Christiania, University Library
Copenhagen, Botanical Society

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Dublin, Royal Dublin Society
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Edinburgh, Government Library, Royal Botanic Garden
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Edinburgh, Royal Physical Society
Edinburgh, Royal Scottish Society of Arts
Edinburgh, University Library

Florence, Nuovo Giornale Botanico Italiana, (Editors)

Glasgow, Natural History Society
Glasgow, Philosophical Society

Königsberg, Physico-Economical Society

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Washington, Smithsonian Institution
Westphalia, Natural History Society

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APPENDIX (C).

PROCEEDINGS.

Thursday, 11*th November* 1875.—Sir ROBERT CHRISTISON, Bart., in the Chair.

The following Candidate was elected a Resident Fellow:—

F. W. MOINET, M.D.

MISCELLANEOUS NOTICES.

1. Mr T. C. Archer, Director of the Museum of Science and Ar. read a note received from W. Dunbar, engineer, dated Cape of Good Hope, 18th September 1875, in which it was stated that a small piece of Petrified Wood was sent to show the petrifying power of Tarka River, near its junction with the Great Fish River, South Africa. The wood is known by the name of Kaffir thorn. Petrifaction must have taken place in a short space of time, as the piece above water showed no sign of decay.

2. Sir W. C. Trevelyan, Bart., presented to the Museum at the Royal Botanic Garden a section from a Branch of an old Spruce Fir, showing remarkable eccentricity of growth, the great development being downwards. (See "Gardeners' Chronicle," March 13, 1875, p. 330). The dimensions of the tree are given in the "Catalogue of Remarkable Trees of Northumberland and Durham," Part I. p. 35. The height of the bole is there given as *twenty*, whereas it was *thirty* feet, and at that height was the branch from which this section was taken. The tree grew at Wallington, Northumberland, and was blown down 20th January 1875.

Thursday, 9*th December* 1875.—W. B. BOYD of Ormiston in the Chair.

The following Office-Bearers for 1875–76 were elected:—

President.

Sir ROBERT CHRISTISON, Bart., M.D., D.C.L., Professor of Materia Medica.

Vice-Presidents.

ALEXANDER BUCHAN, M.A., F.R.S.E. | HUGH CLEGHORN, M.D., F.R.S.E.
CHARLES JENNER, F.R.S.E. | Prof. MACLAGAN, M.D., F.R.S.E.

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Councillors.

David Grieve, F.R.S.E.
William Gorrie, F.R.Cal.Hort.Soc.
Isaac Anderson-Henry, F.L.S., F.R.S.E.
Thomas A. G. Balfour, M.D., F.R.S.E., F.R.C.P.E.
Prof. Rutherford, M.D., F.R.S.E.
W. B. Boyd of Ormiston.
William Craig, M.D., C.M. F.R.C.S.E., F.R.S.E.
Malcolm Dunn, F.R.Cal.Hort.Soc.
George H. Potts of Fettes Mount.
Isaac Bayley Balfour, D.Sc. F.L.S.

Honorary Secretary, . Professor Balfour, M.D., F.R.SS. L. & E.
Honorary Curator, . The Professor of Botany.
Foreign Secretary, . Professor Dickson, M.D., F.R.S.E.
Treasurer, ... Patrick Neill Fraser, F.R.Cal.Hort.Soc.
Assistant-Secretary, . John Sadler, F.R.P.S.

Local Secretaries.

George Dickie, M.D., Professor of Botany, Aberdeen.
John Duncanson, M.D., Alloa.
Philip W. Maclagan, M.D., Berwick.
George A. Panton, St Bennet's Hill, Birmingham.
T. W. Mawson, M.B., C.M., Burringham, Doncaster.
John Anderson, M.D., Calcutta.
Charles C. Babington, Professor of Botany, Cambridge.
W. R. M'Nab, M.D., Professor of Botany, Roy. Col. Science, Dublin.
James Gilchrist, M.D., Dumfries.
Thomas Shapter, M.D., Exeter.
W. H. Campbell, LL.D., Georgetown, Demerara.
Alexander Dickson, M.D., Professor of Botany, Glasgow.
William Keddie, F.R.S.E., 5 India Street, Glasgow.
William Carruthers, F.R.S., British Museum, London.
Benjamin Carrington, M.D., Eccles, Manchester.
Baron Ferdinand von Mueller, M.D., Melbourne, Australia.
William Alexander Stables, Nairn.
George S. Blackie, M.D., Nashville, Tennessee.
John Lowe, M.D., King's Lynn, Norfolk.
George Lawson, LL.D., Dalhousie, Nova Scotia.
John Gibson, B.A., Prov. Normal School, Ottawa, Ontario.
Lauder Lindsay, M.D., F.R.S.E., F.L.S., Perth.
Rev. W. A. Leighton, B.A., F.L.S., Shrewsbury.
John Leitch, M.B., C.M., Silloth.
James Hector, M.D., F.R.S.E., Wellington, New Zealand.
John Kirk, M.D., F.L.S., Zanzibar.

The following Candidates were elected Resident Fellows:—

W. W. Johnstone, Bangholm House.
John Milne of Kevock Tower.
John Thomson, Spylaw Bank.

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MISCELLANEOUS NOTICES.

1. Sir Robert Christison, Bart., exhibited a bundle of Ipecacuan Root, made up commercially, obtained from the plants sent out to Dr King, Calcutta, from the Edinburgh Royal Botanic Garden.

2. Mr C. W. Peach exhibited a specimen of the Leaf of *Dictyophyllum rugosum* found, in September last, in the oolite at Colleyweston, Northamptonshire.

3. Mr James M'Nab, Botanic Garden, exhibited ripe fruits of the Sweet Almond (*Amygdalus persica*), from Mr Robb's garden at Meggetland, near Slateford. The tree was planted in 1824 on a wall having a S.W. aspect. The stem is 2 feet 8 inches in circumference, and about 200 fruits were this year obtained for the first time.

Thursday, 13th January 1876.—ALEXANDER BUCHAN, M.A., in the Chair.

The following Candidate was elected a Resident Fellow:—

J. FALCONER KING, City Analyst.

George Todd Chiene, C.A., was appointed Auditor, and Francis M. Caird, Artist, for 1876.

MISCELLANEOUS NOTICES.

1. Mr John Sadler exhibited specimens of Leeks affected with the entophytic fungus *Uromyces* (Uredo) *alliorum*. He stated that this disease had been common in the Leek fields near Edinburgh last autumn. He also exhibited specimens of *Elymus arenarius* affected with *Ustilago hypodytes*, a purplish-black dusty fungus prevalent during the past summer and autumn on the Forfarshire coast, between Broughty-Ferry and Barry.

2. Dr Cleghorn exhibited an extensive series of Botanical Drawings of Indian Plants (Medical and Economical), executed by Surgeon De Crespigny, of the Bombay Army. These are now in the India Museum.

3. Mr M. Dunn, the Palace Gardens, Dalkeith, presented Fruit of *Chimonanthus fragrans* (Lindl.), and exhibited a specimen of Cypripedium bearing two flowers on the same peduncle; also a double leaf of *Stephanotis floribunda*.

4. Professor Balfour exhibited specimens of young Larch trees destroyed by the attacks of *Hylobius abietis*. They were transmitted by Macpherson Grant, Esq. of Kincorth, near Forres, where the beetle has lately been most destructive.

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5. Mr Peach stated, that in July 1875, he found at Thornhaugh, Northamptonshire, a field of Vetches, grown from French seed, infested by dodder. Patches, several feet square, were destroyed by it. Some of the vetches, cut green, and with plenty of dodder intermixed, were eaten freely by the horses, and no harm ensued. When green, the dodder seemed half the crop, but when dried shrunk into almost nothing. As the dodder grew strong, it entwined and overtopped the vetches, till they died: still the dodder continued to grow, twining on itself, flowering, and maturing its seed plentifully, much of it falling on the ground. Mr Peach suggested that vetch seed should be sifted in fine sieves before sowing; and thus, by taking out the small seed of the dodder, the injury to the vetches might be avoided. He then entered on the question whether dodder is a parasite or epiphyte, and stated his belief in it being the latter.

The paper was illustrated with drawings and specimens of dodder on various plants, and with seeds mounted for the microscope.

Thursday, 10*th February* 1876.—Sir ROBERT CHRISTISON, Bart., in the Chair.

The following Candidates were elected:—

1. *Foreign Honorary Fellow.*

Dr E. STRASBURGER, Professor of Botany, Jena.

2. *Foreign Corresponding Members.*

LUIS SODIRO, Professor of Botany, Quito.

THEODORE VON HELDREICH, Professor of Botany, Athens.

3. *Associate.*

ALEXANDER CAMPBELL, Burntisland.

The Treasurer submitted a detailed Statement of the Accounts of the Society for the Session 1874–75, with the Auditor's report thereon. The income during the year was £120, 15s. 3d., and the expenditure £106, 17s. 6½d., being an increase of £13, 17s. 8½d. over the previous year. The reports were approved of.

MISCELLANEOUS NOTICES.

1. Mr John Sadler made some remarks on the alpine forms of Cerastium which he had recently met with in the Highlands of Scotland. The specimens exhibited included—

Cerastium latifolium, Sm., var. *Smithii*.—Ben Lawers and Cama-Creag, Perthshire, and on Ben Dhorean, Argyllshire, July 1875.

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Cerastium latifolium, var. *compactum*.—Glas Maol, Forfarshire, August 1874, and on Ben Lawers, July 1875.

Cerastium alpinum, Linn., var. *lanatum*.—Ben Lawers, Cama-Creag, and Ben Challum, Perthshire, July 1875; in Canlochan Forfarshire, August 1874; and on Ben Dhorean, July 1875.

Cerastium alpinum, var. *pubescens*.—Cama-Creag and Ben Dhorean, July 1875.

Cerastium triviale, Link., var. *alpestre*.—Glen Dole, Forfarshire July 1872, and on Ben Challum, July 1875.

Cerastium triviale, var. *holosteoides* (alpine form).—Glen Dole, and on Little Gilrannoch, Forfarshire, August 1872.

2. Mr C. W. Peach read a note on some Fern-leaved Beeches growing in the Rectory grounds at Thornhaugh, Northamptonshire. Their age is unknown to the rector (Rev. H. Fuller), who found them thriving trees when he came to the living nearly twenty years ago. They are still flourishing, and were well covered with leaves and fruit last year. One near the entrance gate is surrounded by large oaks, &c., and being overshadowed by their wide-spreading branches, is crooked by having to twist itself to get light and sun. It is about 52 feet high. The other, having room to spread, is a graceful tree. Before branching, the stem is 3 feet 2 inches in height, and from the ground to the tip of the topmost branch, 42 feet. Girth of stem, 4 feet 2 inches. The spread of the branches is 42 feet. This tree is much admired for its leaves and symmetry.

3. Professor Rutherford described a new form of a Freezing Microtome, and showed the mode of using it.

4. Lieutenant Andrew Balfour, R.N., recently returned from the "Challenger" Expedition, exhibited a series of highly interesting Photographs, showing the vegetation and scenery of many places visited by the ship during the voyage. These included, amongst others, Halifax, Nova Scotia, the Cape de Verde islands, the Azores, New Zealand, Kerguelen's Land, the Ki, and other islands in the Indian Archipelago; the Philippine, and Sandwich Islands, Rio de Janeiro, and Tahiti,—the most interesting photograph in the latter group being that of the Tamarind Tree planted by Captain Cook.

Lieutenant Balfour also presented to the University Herbarium specimens of Dried Plants, collected in the Philippine Islands, at 5000 feet above the sea, and also a specimen of the plant from which the perfume called *Elang Elang* is manufactured in Manilla.

5. Professor Alexander Dickson exhibited specimens of a number of Fungi, including *Dædalea quercina*, *Polyporus fomentarius*, and *P. betulinus*.

6. Professor Balfour exhibited a Chart of all the Natural Orders of the Vegetable Kingdom, prepared and published by Professor Hanstein of Bonn.

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Thursday, 9th March, 1876.—Dr CLEGHORN in the Chair.

The following Candidates were elected:—

Foreign Honorary Fellow.

HUGH ALGERNON WEDDELL, M.D., Poictiers.

Foreign Corresponding Member.

EDOUARD MORREN, Professor of Botany, Liege.

Resident Fellows.

Rev. THOMAS ANDERSON. F. C. Manse, Crailing.
MUIR CRAWFORD, 6 Annandale Street.

MISCELLANEOUS NOTICES.

1. Professor Balfour read a note from Mr Robert Garrett regarding a variety of *Eucalyptus viminalis* growing in the open air at Whittinghame, East Lothian. Mr Garrett says—"It was raised from seed, by the gardener about thirty years ago, and has been growing in its present situation, as nearly as I can ascertain, about twenty-years. In 1861 it had attained the height of about 25 feet, and was then a symmetrical tree. During that spring, along with many other plants, it was nipped by frost, and was cut over at 9 feet from the ground. It remained standing like a post, without signs of life for some time. This led to the conclusion that it was dead, and it was ordered to be taken out. The men had begun to root it up, when one of them discovered a bud about to burst. On this being reported to the gardener he decided to let it remain. It threw out several shoots from near the base, and also some from near the top of the old stem where it had been cut over. A few years later some lower shoots were layered, and several young plants raised therefrom, but all of them have now disappeared. The original plant is now between 48 and 50 feet high. The main or old stem, at one foot from the ground, which is the smallest part of it, is 7 feet 10 inches in circumference. The main branch, issuing from near the top of the old stem, is 4 feet 10 inches in circumference; one of the other branches springing from near the base is 3 feet 4 inches, and another 3 feet 1 inch. There are several others of smaller dimensions." Specimens of the plant had been submitted to Mr Bentham, who believes it to be a variety of *E. viminalis*.

2. Dr F. Douglas, Kelso, made a few remarks on the different kinds of Tea cultivated in the North-West Provinces of India. The tea plant, he stated, was introduced into India about twenty-five years ago from China by Mr Fortune, well known as an Oriental traveller. Its cultivation received liberal encouragement from the Government, who did everything they could to develope the Indian tea trade, and now about one-sixth of the tea imported

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into this country comes from India. The different kinds of tea which are sold are gathered from the same plant, the varieties of black, green, &c., depending on the freshness of the leaves and the mode in which they are manipulated. The more delicate leaves, of course, make the finest tea. Professor Balfour remarked that Prussian blue and other colouring agents were used in China in the production of green tea. Dr Douglas said that on his plantation no such adulteration took place. The different varieties were solely due to the way in which the leaves were manipulated. Dr Douglas presented to the Museum of the Botanic Garden samples of twelve different kinds of tea from his plantation in Kumaon, in the North-West Provinces.

Thursday, 13th April 1876.—Sir ROBERT CHRISTISON, Bart., in the Chair.

The following Candidates were elected Resident Fellows:—

JAMES ROBSON SCOTT, M.D., Abercromby Place.
WILLIAM THOMSON, 13 St Andrew Square.

MISCELLANEOUS NOTICES.

1. Mrs Tennant exhibited a truss of nine flowers of *Rhododendron Nuttallii* grown in her garden at The Glen. The plant is about 15 feet in height, and stood for many years in the corner of a conservatory. Three years ago it was placed in a small tub, and began to produce flowers; this spring it developed six trusses similar to the one shown.

2. Professor Balfour read the following extract from a letter sent by Mr Maw of Benthall Hall :—"I have returned from Italy, and send you a box of roots of several species of *Crocus*, including *C. etruscus* (Parlatore), which has never before been in cultivation, and, indeed, has only been known from Parlatore's description, and three or four specimens in the Florence Herbarium. In company with Mr Gommier I had the good fortune to rediscover it in the old habitat, and also in a new locality in the Tuscan Maremma."

Thursday, 11th May 1876.—Sir ROBERT CHRISTISON, Bart., in the Chair.

The following Candidate was elected a Foreign Corresponding Member:—

NICOLAO TERRACCIANO, Director of the Royal Gardens, Caserta, Naples.

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MISCELLANEOUS NOTICES.

1. Dr Cleghorn gave an account of a visit he had made, in May 1875, to the Forest School at Vallombrosa, near Florence. He sketched the progress of forest legislation in Italy, and expressed his obligations to Cavaliere A. di Berenger, the estimable Director of the Royal School of Forestry (Instituto Forestale di Vallombrosa), formerly in the Austrian Forest service at Trieste. Dr Cleghorn saw the system of training, and visited the tract assigned to the Institution, including a superb forest of silver fir, *Abies pectinata*, on the slopes of the Apennines, about 25 miles from Florence. A detailed account of the trip, very pleasant and instructive to forest officers, will be found in the "Transactions of the Scottish Arboricultural Society," Vol. VIII.

2. Mr Charles Howie sent a number of Primroses from his garden at Largo. In form and colour the flowers exhibited great variety, although originally raised from the seed of the common primrose (*Primula vulgaris*).

3. Isaac Anderson-Henry, of Hay Lodge, exhibited a growing plant of a species of *Bupleurum;* the seeds, collected in Tibet at an elevation of 11,300 feet, were sent to him by Dr H. W. Bellew, of the Embassy to Kashgar.

He also exhibited a Hybrid Rhododendron between *R. Henryanum* and *R. Veitchii*, the former being the seed-bearer. The flowers are 5 inches across, pure white, fringed, and sweet-scented.

4. A note was read from Professor Wyville Thomson, enclosing seeds of a fine species of *Vinca* from Ascension. Its flowers are 2 inches across, and of a pure creamy white.

Thursday, 8th June 1876.—WILLIAM GORRIE, of Rait Lodge, in the Chair.

The following Candidate was elected a British Honorary Fellow :—

GEORGE DICKIE, A.M., M.D., F.L.S., Professor of Botany, Aberdeen.

MISCELLANEOUS NOTICES.

1. Dr Alex. Hunter delivered a Lecture on the Diseases affecting certain Garden Plants and Trees.

2. Mr John Sadler gave a demonstration on the Phyllotaxis of the young shoots of some Coniferæ, and illustrated his remarks by specimens. He also exhibited specimens of *Lathyrus maritimus*, recently collected on the Forfarshire coast by Mr Simson.

3. A note was read from Dr Dyce Duckworth on the Germination of some Melon Seeds within the ripe fruit.

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4. D. Grieve, F.R.S.E., noticed several Fossil Plants he had met with in the Coal-fields near Bristol in August 1875. Near Radstock, a village 15 or 16 miles from Bristol, are many collieries. Here he found an abundance of fossil plants, illustrating the orders Filices, Equisetaceæ, and Lycopodiaceæ. The ferns were mostly casts; the clay in which they are moulded is very fine, and the venation of the plant is shown to great advantage. The variety is also great, and the close juxtaposition of plants wonderful. A small specimen, little more than 3 inches superficial measure, was exhibited, in which eight species of three genera of Ferns are collocated. The genus Pecopteris is best represented. Of Sphenopteris only two species were found.

Radstock is rather out of the way, and is seldom visited by fossil collectors; however, in its carboniferous strata there lies a large field for discovery.

The following Fossil plants were identified by Mr Grieve:—

Neuropteris aculeata, *Lindl. et H.*
acuminata, *Brongn.*
cordata, *Brongn.*
attenuata, *Lindl. et H.*
tenuifolia, *Brongn.*
angustifolia, *Ett.*
heterophylla, *Brongn.*
elegans, *Brongn.*
Cistii, *Brongn.*
Pecopteris sinuata.
Miltoni, *Brongn.*
Serra, *Lindl. et H.*
Cyathea, *Brongn.*
marginata, *Brongn.*
abbreviata, *Brongn.*
dentata, *Brongn.*
aspidoides, *Brongn.*
Pecopteris Bucklandi, *Brongn.*
arborescens, *Schloth.*
oreopteridea, *Brongn.*
aquilina, *Brongn.*
Davreuxii, *Brongn.*
hemitelioides, *Brongn.*
Sphenopteris adiantoides, *Lindl. et H.*
multifida.
Sphenophyllum Schlotheimii, *Brongn.*
Sigillaria tessellata, *Brongn.*
Trigonocarpum(undetermined).
Lepidodendron Selaginoides, *St.*
Lepidophyllum (various).
Calamites cannæformis, *Gein.*
Annularia (undetermined).

Thursday, 13th July 1876.—Sir ROBERT CHRISTISON, Bart., in the Chair.

The following Candidates were elected Resident Fellows:—

ROBERT GRAY, F.R.S.E., 13 Inverleith Row.
JONATHAN E. LEES, Portobello.
ALEXANDER STEVENSON, 3 Grindlay Street.
FREDERIC M. WEBB, Herbarium, Royal Botanic Garden.

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MISCELLANEOUS NOTICES.

1. Dr Cleghorn gave an account of an Excursion which he had made to the Chôr Mountain, near Simla, in October 1866. This remarkable peak of the North-Western Himalaya (elevation 12,149 feet) is only 30 miles from the plains, and 25 south-east from Simla. It was visited by J. Baillie Fraser, Hodgson, Herbert, Webb, and the earlier Himalayan explorers, and from the collection of Drs Govan and Royle, and Col. Madden, is a well known botanical habitat. Of late years travellers in large numbers have been attracted by the facilities afforded by the Hindostan and Tibet road, and the passes into Kashmir, and comparatively few now visit this isolated mountain. The ascent can be easily accomplished on the third day from Simla, and the fauna and flora are most interesting. Dr Cleghorn gave a list of 14 mammalia, 64 birds, 3 reptiles, observed about the Chôr Mountain, the birds having been identified by the late Dr Stoliczka. The ordinary Himalayan trees are at first met with in the ascent. Above the pines the grassy slope was covered with a profusion of flowers, many of them in fruit, viz., *Primula, Androsace, Potentilla, Anemone, Viola, Morina*, and near the top the beautiful *Meconopsis aculeata*, seeds of which germinated in the Kew, Liverpool, and Edinburgh Gardens.

2. Mr Anderson-Henry placed on the table the following Plants:—

(1.) *Campanula macrochlamys* (Bowse), received from Max Leitchtlin, Baden-Baden, who states that "it has very large upright flowers, white and blue, chequered like *Fritillaria Meleagris*." The length of style, the singular envelope that sheathes the stigma, and the short incurved stamens at the base of the style, render it unique in the tribe in which Mr Bowse has classed it.

(2.) Species of Centaurea, 1 foot high, with peculiar but pleasantly scented purple flowers. The seeds were sent from Tibet to Mr Anderson-Henry by his nephew, Col. Johnstone of the Trigonometric Survey. They partake of various shades of purple, and are very like annuals.

(3.) Fern raised from New Zealand spores sent by Mr Purdie. It looks like Cheilanthes, but may be different.

(4.) *Salvia Moorcroftiana*, raised from seed sent from Kashmir by Mr Anderson-Henry's niece (Mrs Johnstone) last summer. One of the plants was put out on a rockery, where it sent up a main stem and about ten branches such as that exhibited, all loaded with bloom. Specimens were sent to Dr Hooker, who replies—"Your noble Salvia is *S. Moorcroftiana*, Wall."

(5.) An umbelliferous plant raised from seeds sent by Col. Johnstone from Tibet.

(6.) A hybrid Silene raised, from *S. Hookeriana* and *S. Elizabethæ*, both lovely species, the former from Oregon, and the latter from the Tyrol. While the female is fertile, the male organs appear to be sterile.

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3. Professor W. R. M'Nab exhibited under the microscope specimens of the rare alga *Chorœolox Polysiphoniæ*, which is parasitic on *Polysiphonia fastigiata*. The specimens were collected in Dublin Bay, July 1875.

4. Mr J. Sadler exhibited specimens of *Œnanthe Phellandrium*, collected recently near Ladybank, Fifeshire. The plant has not been met with near Edinburgh for a number of years.

5. Miss Hope of Wardie Lodge exhibited monstrous forms of *Campanula media* and *Saxifraga hieracifolia*, the former having apparently eight flowers united into one terminal flower.

STATISTICS OF THE BOTANICAL CLASS FOR 1876.

Number of pupils, 343; of these 312 were medical students, 24 general students, and 7 pharmaceutical students. Students of first year, 229; Advanced students, 114. Pupils of the Class of Vegetable Histology and Practical Botany, 66.

Number of Lectures, 57; Demonstrations in the Botanic Garden, 7; Histological Demonstrations, 43; Competitive Examinations, 2; Excursions, 9.

The following were the Excursions:—1. Roslin and Polton. 2. Kinghorn and Burntisland. 3. North Queensferry. 4. Lindores and Newburgh. 5. Rutherford and Kelso. 6. Guard Bridge and Tents Muir. 7. Dirleton and North Berwick. 8. Springfield, Rankeillor, and Melville Woods, Ladybank. 9. Tyndrum, Ben Leoagh, Lochearn Head, and Ben Voirlich.

Number of Species of Plants collected during the Excursions:—Phanerogamous Plants, 540; Ferns and their Allies, 30; other Cryptogams, 80; Total, 650.

Number of miles travelled by railway, steamboat, and walking, 600. The number of Students who attended the Excursions was 233; and the number at each Excursion varied from 30 to 210.

Number of fresh specimens of plants used during the Session to illustrate the lectures and demonstrations, 49,000.

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ADDITIONS

TO THE

LIBRARY, HERBARIUM, AND MUSEUM,

AT THE

ROYAL BOTANIC GARDEN, EDINBURGH,

FROM LAST YEAR'S STATEMENT TO 30TH SEPTEMBER 1876.

I.—LIBRARY.

BOOKS.

BALFOUR, J. H. (Prof.) Outlines of Botany, designed for Schools and Colleges. Second Ed. Edinburgh, 1862. 8vo.

——— First Book of Botany. (*Collins' Elementary Science Series.*) London, 1873. 8vo.

——— Second Book of Botany. (*Ditto.*) London, 1873. 8vo.

——— Guide to the Royal Botanic Garden, Edinburgh. 8vo.—*From the Author.*

BLYTT, AXEL. Norges Flora. Med Bistand af Prof. *M. Blytt* efterladte Samlinger og Optegnelser af *A. Blytt.* 2 det Bind.—*From Royal University of Norway.*

BOMFIN, ANT. M. De. Elementos de Anatomia, Physiologia e Morphologia Vegetal. Bahia, I. Fasciculo, 1873; II. Fasc. 1875. 8vo.—*From the (late) Author.*

CARRINGTON, B. British Hepaticæ. Part 4. (May 1875.)—*From the Author.*

CLARKE, C. B. Compositæ Indicæ Descriptæ et secus genera Benthamii ordinatæ. Calcutta, 1876. 8vo.—*From Prof. Balfour.*

COPE, E. D. *See* Washington, p. lx.

CRAIG, WILLIAM. *See* Milne, p. li.

HANCOCK, JOHN. *See* Newcastle, p. lix.

HAYDEN, F. V. *See* Washington, p. lx.

HEER, OSWALD. Die Kreide-Flora der Arctischen Zone. (Ex.—"K. Sv. Vet. Akad. Handl. 1874.") 4to.—*From Royal Swedish Academy.*

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HELDREICH, THEODOR VON. Die Nutzpflanzen Griechenlands. Athen, 1862. 8vo.—*From the Author.*

HOOKER, JOSEPH D. The Flora of British India. Part IV.—Anacardiaceæ, &c.; *J. D. Hooker.* Leguminosæ (in part); *J. G. Baker.*—*From Sec. of State for India.*

JACKSON, B. DAYDON. A Catalogue of Plants cultivated in the Garden of *John Gerard*, in the years 1596–1599. With notes, references to *Gerard's Herball*, the addition of modern names, and a Life of Gerard. London (privately printed), 1876. 4to. Presentation copy, No. 7.—*From the Editor.*

KŒCHLIN-SCHLUMBERGER, J., and SCHIMPER, W. P. Mémoire sur le Terrain de Transition des Vosges. Strasbourg, 1862. 4to. (Mémoires de la Soc. de Sc. Nat. de Strasbourg, tome xv. liv. 2, 3.)—*From W. P. Schimper.*

MANSEL-PLEYDELL, J. C. Flora of Dorsetshire: or, A Catalogue of Plants found in the County of Dorset, with Sketches of its Geology and Physical Geography. London, 1874. 8vo.—*From the Author.*

MEEK, F. B. *See* Washington, p. lx.

MILNE, ALEXANDER. Manual of Materia Medica and Therapeutics. Third edition, revised, enlarged and re-arranged by *Wm. Craig, M.D.* Edinburgh, 1876. Sm. 8vo.—*From Dr W. Craig.*

MORREN, CHARLES. Clusia: Recueil d'Observations de Tératologie Végétale. Avec une Préface et une Introduction par *Edouard Morren.* Liége, 1852–74. 8vo.—*From M. E. Morren.*

MORREN, EDOUARD. Charles de l'Escluse, sa vie et ses œuvres. 1526–1609. (*Repr. from Bull. Soc. d'Hort. de Belgique*, 1874.) Liége, 1875. 8vo.

——— La Belgique Horticole. Annales d'Horticulture et de Botanique. 1875. Liége, 8vo.—*From the Author.*

PACKARD, A. S., Jr. (M.D.) *See* Washington, p. lx.

RAY, JOHN. Historia Plantarum. Tomus i. et ii. Londini, 1686 and 1688.—*From Thos. Walker of Corluke.*

SCHIMPER, W. P. *See* Kœchlin—Schlumberger.

SCHOMBURGK, R. Flora of South Australia. Adelaide. 1875. 8vo. (Ex.—"The Handbook of S. Australia.")—*From the Author.*

TERRACCIANO, NICOLAO. Floræ Vulturis Synopsis. Neapoli, 1869. 4to.—*From the Author.*

THOMPSON, J. V. A Catalogue of Plants growing in the vicinity of Berwick-upon-Tweed. London, 1807. 8vo.—*From F. M. Webb.*

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THE FOLLOWING ARE A FURTHER DONATION FROM THE LIBRARY OF THE LATE DR JOSEPH DICKSON, F.L.S. *Presented by J. F. Dickson, Esq.*

AGARDH, CARL ADOLPH. Lehrbuch der Botanik. Allgemeine Biologie. A. d. Schwedischen von *F. C. H. Creplin.* Mit Vorrede von *Hornschuch.* Griefswald, 1832. 8vo.

BARTLING, FRIED. GOTT. Ordines naturales plantarum eorumque characteres et affinitates adjecto generum enumeratione. Goettingæ, 1830. 8vo.

BLUME, KARL LUDWIG. Enumeratio plantarum Javæ et insularum adjacentium minus cognitarum vel novarum ex herbariis *Reinwardtii, Kohlii, Hasseltii et Blumii.* Lugduni Batavorum, 1827–28. 8vo.

BURNETT, GILBERT T. Outlines of Botany, &c. (Incomplete). Parts 1–3. London, 1833. 8vo.

CRUSE, WILHELM. De Rubiaceis capensibus, præcipue de genere Anthospermo. Berolini, 1825. 4to.

ENDLICHER, STEPHEN LADISLAUS. Genera plantarum secundum ordines naturales disposita. Accedit supplementum primum. Vindobonæ, 1836–40. Small 4to.

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HENSLOW, J. S. The Principles of Descriptive and Physiological Botany. London, 1835. 8vo. (Forming vol. 75 of *Dr Lardner's* "Cabinet Cyclopædia.")

JUSSIEU, ANTOINE LAURENT DE. Genera plantarum secundum ordines naturales disposita. Parisiis, 1789. 8vo.

LABAT, LÉON. De l'Irritabilité des plantes. Paris, 1834. 8vo.

LEIBIG, JUSTUS. Organic Chemistry in its applications to Agriculture and Physiology. Edited by *Dr Lyon Playfair.* London, 1840. 8vo.

LINDLEY, JOHN. A Key to Structural, Physiological, and Systematical Botany, for the use of Classes. London, 1835. 8vo.

——— Nixus Plantarum. Londini, 1833. 8vo.

——— A Synopsis of the British Flora. London, 1829. 12mo.

——— The Genera and Species of Orchidaceous Plants. (Incomplete.) Parts 1–4. London, 1830–35. 8vo.

LINDLEY, JOHN, and HUTTON, WILLIAM. The Fossil Flora of Great Britain. (Incomplete.) Vol. I. London, 1831–33. 8vo.

LODDIGES, CONRAD. Orchideæ in the Collection of *Conrad Loddiges and Sons.* London, 1842. 12mo.

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NEES VON ESENBECK, C. G. Handbuch der Botanik. 2 Bande. Nürnberg, 1820–21. 8vo.

RASPAIL, FRANÇOIS V. Nouveau système de physiologie végétale et de botanique. 2 tom et Atlas. Paris, 1837. 8vo.

REICHENBACH, H. G. L. Flora Germanica excursoria. Lipsiæ, 1830–32. 12mo.

RICHARD, ACHILLE. Mémoire sur la famille des Rubiacées. Paris, 1829. Fcp.—*See also* Turpin, P. J. F.

SMITH, JAMES EDWARD. An Introdution to Physiological and Systematic Botany. Ed. V. London, 1825. 8vo.

——— Compendium Floræ Britannicæ. Ed. IV. London, 1825. 12mo.

SPRENGEL, CHRISTIAN KONRAD. Das entdecte Geheimness der Natur im Bau und in der Befruchtung der Blumen. Berlin, 1793. 4to.

SPRENGEL, KURT. *Caroli Linnaei* Systema vegetabilium. Editio XVI., curante *Kurt Sprengel.* V. partes. Goettingæ, 1825–28. 8vo.

SWEET, ROBERT. *Sweet's* Hortus Britannicus, or a Catalogue of Plants cultivated in the Gardens of Great Britain. Third edition, edited by *George Don.* London, 1839. 8vo.

TURPIN, PIERRE J. F. Iconographie végétale . . . . . Avec un texte explicatif raisonné, &c., par *Achille Richard.* Paris, 1841. Small 4to.

UNGER, FRANZ. Ueber den Einfluss des Bodens auf die Vertheilung der Gewächse, nachgewiesen in der Vegetation des nordöstlichen Tirols. Wein, 1836. 8vo.

WATSON, HEWETT COTTRELL. Remarks on the Geographical Distribution of British Plants. London, 1835. 8vo.

WILLSHIRE, W. HUGHES. The Principles of Botany. London, 1840. 8vo.

MAPS.

HECTOR, JAMES. Geological Sketch Map of New Zealand, constructed from Official Surveys and Explorations. Wellington, 1873. Scale 12 in. to mile. 33 × 22 in.—*From Dr Hector, F.R.S.*

PAMPHLETS, REPRINTS FROM SCIENTIFIC PUBLICATIONS, &c.

AGARDH, J. G. Grönlands Laminarieer och Fucaceer. (Ex.—"K. Sv. Vet. Akad. Handl. 1872.")—*From Royal Swedish Academy.*

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ALMQUIST, S. Berätt. om en Resa i Angermanland, & 1873. (Ex.—"K. Vetensk. Akad. Förhandl. 1874.")—*From Royal Swedish Academy.*

ANGSTRÖM, JOH. Mossor fran Eugenies verldsomsegling, 1851–53. (Ex.—"K. Vetensk. Akad. Förhandl. 1872.")

——— Mossor, saml. under Eugenies verldsomsegling, 1851–53. (Ex.—"Id. 1873.")—*From Royal Swedish Academy.*

ARESCHOUG, F. W. C. Trapa natans, L. (Ex.—"K. Vetensk. Akad. Forhandl. 1873.")—*From Royal Swedish Academy.*

BALFOUR, J. H. (Prof.) Notes of an Excursion made by the Scottish Alpine Club . . . . in August 1874. (Same as in "Trans. Edin. Bot. Soc., XII. pt. II.")—*From the Author.*

BERGGREN, S. Fanerogamfloren pa Grönland. (Ex.—"K. Vetensk. Akad. Förhandl. 1871.")

——— Alger fran Grönlands inlandis. (Ex.—"Id.")—*From Royal Swedish Academy.*

BLYTT, A. Bidrag til Kundskaben om Vegetationen paa Nowaji Semlja, Waigatschöen og ved Jugorstrædet. (Ex.—"Vitensk. Selsk. Forhandl. 1872.")—*From the Author.*

BOUVIER, LOUIS. Les Roses des Alps. (Formant le tome XIX. du Bulletin de l'Institut Genevois.) Genève, 1875. 8vo.—*From F. M. Webb.*

BROWN, ROBERT. The Botanical History of Angus. (A Paper read by the after celebrated R. B., before Edin. Nat. Hist. Soc. in 1792.) (Repr.—"J. of Bot. Nov. 1871.")—*From Dr H. Trimen.*

CANDOLLE, ALPH. DE. L'age d'un arbre a-t-il une influence sur l'èpoque moyenne de sa feuillaison? (Ex.—"Arch. des Sciences de la Bibl. Univ. June 1876.")—*From the Author.*

CANDOLLE, C. DE. Sur la structure et les mouvements des feuilles du Dionæa muscipula. (Ex.—"Arch. des Sciences Phys. et Nat. April 1876.")—*From the Author.*

CHRISTISON, ROBERT (Sir). Observations on the Effects of Cuca or Coca. (Repr. from "Brit. Med. Journ. April 1876.")—*From the Author.*

CLEVE, P. T. Diatoms of the Sea of Java. (Ex.—"K. Sv. Vet. Akad. Handl. 1873.")

——— On Diatoms from the Arctic Sea. (Ex.—"Id.")—*From Royal Swedish Academy.*

COOKE, M. C. Notes on the Discomycetes of the Edinburgh University Herbarium. (Ex.—"Trans. Edin. Bot. Soc. XII. pt. II.")—*From the Author.*

CRAIG, WILLIAM. On the External Uses of the Hydrate of Chloral (Repr.—"Edin. Med. Journ. Feb. 1876.")

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CRAIG, WILLIAM. Note on Jaborandi. (Repr.—"Id. Jan. 1876.")

——— Notes on "Changed Aloin," and The Resin of Aloes. (Repr. "Id. 1875.")—*From the Author.*

DÉSÉGLISE, ALFRED. Révision de la Section Tomentosa du genre Rosa. (Ex.—"Mem. de la Soc. Acad. d'Angers, tome XX. 1866.")

——— Descriptions de quelques espèces nouvelles du genre Rosa. (Repr.—"Mem. de la Soc. Acad. de Maine-et-Loire, tome XXVIII. Angers, 1873.")

——— Descriptions de quelques espèces nouvelles du genre Rosa. (Ex.—"Billotia.")

——— Observations sur les *Rosa Balearica*, Desf. et *R. Vosagiaca*, Desp. (Ex.—"J. of Bot. March 1874.")

——— Notes extraites de l'énumération des Rosiers de l'Europe, de l'Asie, et de l'Afrique. (Ex.—"Id. June 1874.")—*From F. M. Webb.*

FRIES, E. Queletia, novum Lycoperdaceorum genus. (Ex.—"K. Vetensk. Akad. Förhandl. 1871.")

——— Decas Hymenomycetum. (Ex.—"Id. 1873.")—*From Royal Swedish Academy.*

GIBSON, JOHN. *See* Macoan, John, p. lvi.

HERR, OSWALD. Anmärkn. öfver Nordgronlands Kritflora. (Ex.—"K. Vetensk. Akad. Förhandl. 1871.")

——— Miocena växter fran Grönland, 1870. (Ex.—"Id. 1873.")

——— Fossila växter fran ön Sachalin. (Ex.—"Id. 1874.")

——— Fössila växter. 1872–73. (Ex.—"Id.")

——— Beiträge zur Steinkohlen—Flora der arctischen zone. (Ex. "K. Vet. Akad. Handl. 1874.")—*From Royal Swedish Academy.*

HELDREICH, TH. DE. Sertulum plantarum novarum vel minus cognitarum Floræ Hellenicæ. (Ex.—"Atti del Congresso Bot. Inter. di Firenze, 1874.")

——— Descrizione di una nuova specie di *Lotus* della flora Italiana. (Ex.—"Nuovo Giornale Bot. Ital. Oct. 1875.")

——— Tulipa Hageri, Heldr. T. Orphanidea, Boiss, und die Tulpen Griechenlands. (Ex.—"Gartenflora.")—*From the Author.*

KARSTEN, P. A. Fungi Spetsbergenses. (Ex.—"K. Vetensk. Akad. Förhandl. 1872.")—*From Royal Swedish Academy.*

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KLEEN, E. Nordlandens hafsalger. (Ex.—"K. Vetenek. Akad. F rhandl. 1874.")—*From Royal Swedish Academy.*

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MACMILLAN, HUGH (Rev.) The Rare Lichens of Glencroe. (Ex.—"Trans. Edin. Bot. Soc. XII. pt. II.")—*From the Author.*

MACOAN, JOHN, and GIBSON, JOHN. The Rarer Plants of the Province of Ontario. (Ex.—"Trans. Edin. Bot. Soc. XII. pt. II.")—*From the Authors.*

MARTINS, CHARLES. Valeur et concordance des preuves sur lesquelles repose la Théorie de l'Evolution en histoire naturelle. (Ex. –"Revue de Deux Mondes, Feb. 1876.")—*From the Author.*

MORREN, EDOUARD. Correspondence Botanique. Liste des Jardins, des Chaires et des Musées Botaniques du Monde. Troisième édition. Liége, 1875. 8vo.

——— Memorandum des Travaux de Botanique . . . publiés par l'Academie Royale des Sciences de Belgique pendant 1772-1871. Bruxelles, 1872. 8vo.

——— La Question des Examens Universitaires. Deuxième édition. Bruxelles, 1876. 8vo.

——— La Théorie des Plantes Carnivores et Irritables. (Ex.—"Bull. de l'Acad. Roy. de Belgique, 1875.")

——— Observations sur les Procédés Insecticides des *Pinguicula* (Ex.—"Id.")

——— Note sur les Procédés Insecticides du *Drosera rotundifolia*, L. (Ex.—"Id.")

——— Note sur le *Drosera binata*, Labill. (Ex.—"Id.")—*From the Author.*

MOSÉN, HJALMAR. Moss-studier pa Kolmoren. (Ex.—"K. Vetensk. Akad. Förhandl. 1873.")—*From Royal Swedish Academy.*

MUNFORD, GEORGE (Rev.) A List of Flowering Plants found growing wild in Western Norfolk. (Ex.—"Ann. and Mag. of Nat. H. 1841.")—*From F. M. Webb.*

NATHORST, A. Arkt. vaxtlemn. i Skane. (Ex.—"K. Vetensk. Akad. Förhandl. 1872.")

——— Den arktiska vegetationen. (Ex.—"Id. 1873.")

——— Förmodade växtfossilier. (Ex.—"Id.")—*From Royal Swedish Academy.*

NORDSTEDT, O. Desmidiaceæ Spetsbergenses. (Ex.—"K. Vetensk. Akad. Förhandl. 1872.")—*From Royal Swedish Academy.*

NORMAN, J. M. Conjectura de affinitate mutua Heterslichenum. 1871.—*From the Author.*

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——— Vegetation du Salève. (Ex.—"Id.")—*From F. M. Webb.*

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SCHEUTZ, J. Om Slägtet Rosa. (Ex.—"K. Vetensk. Akad. Förhandl. 1873.")—*From Royal Swedish Academy.*

SCHOMBURGH, R. Report of the Progress and Condition of the Botanic Garden and Government Plantations, during years 1873 and 1875. Adelaide, 1874 and 1876. Fol.—*From the Author.*

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——— Växt-trichomernas formförändringar. (Ex.—"K. Vetensk. Akad. Förhandl. 1872.")—*From Royal Swedish Academy.*

TODARO, AGOSTINO. Fourcroya elegans, *Tod.* (Ex.—"Hortus Bot. Panormitanus, 1876.")—*From Sir Robert Christison.*

TRIMEN, HENRY. Botanical Bibliography of the British Counties. (Ex.—"J. of Bot. for 1874, and Revised with Additions.")—*From the Author.*

WARREN, J. L. (Hon.) On *Triticum pungens*, Koch. (Ex.—"J. of Bot. Dec. 1874.")—*From F. M. Webb.*

WEDDELL, H. A. Excursion Lichenologique dans l'Ile d'Yeu. (Ex. —"Mem. Soc. Sc. Nat. de Cherbourg, tome XIX., 1875.")

——— Les Calamagrostis des hautes Andes. (Ex.—"Bull. de la Soc. Bot. de France, tome XXII. 1875.")—*From the Author.*

WILSON, ALEX. S. On the Fertilization of the Cereals. (Ex.—"Trans. Edin. Bot. Soc. XII. pt. II.")—*From the Author.*

WITTROCK, V. B. Gotlands och Olands Sötvattens-algar. (Ex.—"K. Sv. Vet. Akad. Handl. 1872.")—*From Royal Swedish Academy.*

ZETTERSTEDT, J. E. Vegetationeni vid Altenfjord. (Ex.—"K. Vetensk. Akad. Förhandl. 1874.")—*From Royal Swedish Academy.*

TRANSACTIONS, &c., OF LEARNED SOCIETIES, ACADEMIES, AND KINDRED INSTITUTIONS.

ALLOA.—Society of Natural Science and Archæology.
Proceedings, 1873 and 1874.—*From the Society.*

BELFAST.—Belfast Naturalists' Field Club.
Annual Report and Proceedings, 1874–5, 1875-6.—*From the Club.*

BERLIN.—Botanishchen Vereins der Provinz Brandenburg.
Verhandlungen: Jahrgang XVII (1875.)—*From the Society.*

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BERNE.—Naturforschenden Gesellschaft in Bern.
Mittheilungen, 1874, No. 828–873; 1875, No. 878-905.—*From the Society.*
Schweizerischen Naturforschenden Gesellschaft.
(in Chur), Verhandlungen. Jahresbericht, 1873–4.
(in Andermatt), „ „ 1874–5.—*From the Society.*

BONN.—Naturhistorischen Vereines der preussischen Rheinlande und Westfalens.
Verhandlungen. Jahrgang XXXI. 2 (1874); XXXII. 1 (1875).—*From the Society.*

BOSTON.—Massachusetts Horticultural Society.
Transactions for 1876. Part 1.—*From the Society.*
Boston Society of Natural History.
Proceedings. Vol. XVII. Pts. 3, 4; Vol. XVIII. Pt. 1. 2.
Memoirs. Vol. II. Pt. 4; Nos. 2–4.
Occasional Papers. II. (The Spiders of the U.S., by N. M. Hentz, M.D.)—*From the Society.*

BREMEN.—Naturwissenschaftlichen Vereine zu Bremen.
Abhandlungen. IV. Bd. 4 Heft (1875); V. Bd. 1 Heft (1876); Beilage, Nos. 4 and 5.—*From the Society.*

CHERBOURG.—Société (Nationale) des Sciences Naturelles de Cherbourg.
Mémoires. Tome XIX., 1875.—*From the Society.*

COPENHAGEN.—Botaniske Forening i Kobenhavn.
Botanisk Tidsskrift (Journal de Botanique). Ser. III. Vol. I. Pt. 1, 1875.—*From the Society.*

EDINBURGH.—Botanical Society of Edinburgh.
Transactions and Proceedings. Vol. XII. Pt. 2 (Session XXXIX.).—*From the Society.*
Royal Scottish Society of Arts.
Transactions. Vol. VIII. Pt. 5; Vol. IX. Pts. 1–3.—*From the Society.*
Royal Botanic Garden of Edinburgh.
Report for the year 1875.—*From the Regius Keeper.*
Scottish Arboricultural Society.
Transactions. Vol. VIII. Pt. 1.
Proceedings of 22d Annual Meeting.—*From the Society.*

GLASGOW.—Natural History Society of Glasgow.
Proceedings. Vol. II. Pt. 2 (1876).—*From the Society.*
Philosophical Society of Glasgow.
Proceedings. Vol. X. Pt. 1 (1875–6).—*From the Society.*

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HAARLEM.—Musée Teyler.
Archives. Vol. I. II., III., et IV. fasc. 1.—*From the Institution.*
KONIGSBERG.—Physikalisch-Okonomischen Gesellschaft zu Königsberg.
Schriften. 1873, 1874.—*From the Society.*
LEEDS.—The Leeds Naturalists' Club and Scientific Association.
Annual Report. 1875–76.
Constitution.
LIVERPOOL.—Literary and Philosophical Society of Liverpool.
Proceedings. No. XXIX. (Session 1874-75).—*From the Society.*
LONDON.—Linnean Society.
Journal—Botany. Vol. XV. Nos. 82–85.—*From the Society.*
Pharmaceutical Society.
Journal and Transactions. 1875–76.—*From the Society.*
Calendar. 1876.
Quekett Microscopical Club.
Journal. Nos. 30–32.—*From the Club.*
LUND.—Universitatis Lundensis. (Lunds Universitets.)
Acta. (Ars-skrift,—Mathematik och Naturvetenskap). Tom. VIII., IX., X., (1871–73.)
Biblioteks Accessions-Katalog. 1872–74.—*From the University.*
LYONS.—Société Botanique de Lyon.
Annales. 1872–3; 1873–4; 1874–75, Nos. 1 and 2. (Contains, Catalogue of the Rhone Basin flora, by Dr Saint Lager, up to *Onobrychis*).—*From the Society.*
MANCHESTER.—Literary and Philosophical Society of Manchester.
Proceedings. Session 1874–75, pp. 117–155.
Index to Vol. XIV.—*From the Society.*
MELBOURNE.—Victoria Patent Office.
Patents and Patentees. Vol. VIII. Indices for the year 1873. By Richard Gibbs.—*From the Office.*
NEWCASTLE.—Tyneside Naturalists' Field Club.
Natural History Transactions of Northumberland and Durham. Vol. V. Pt. 2, and Vol. VI. (Contains, Catalogue of the Birds of Northumberland and Durham, by John Hancock, with fourteen copperplates).—*From the Club.*
NEWPORT.—(Vermont). Orleans County Society of Natural Sciences.
Archives and Transactions. Vol. I. Nos. 8 and 9.—*From the Society.*
NORWICH.—Norfolk and Norwich Naturalists' Society.
Transactions. Vol. II. Pt. 2 (1875–76).—*From the Society.*

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PARIS.—Société Botanique de France.

Bulletin. Comptes-rendes, Tome XXII. (1875) 3, et XXIII. (1876), 1, 2.

Revue Bibliographique. Tome XXII. C. D. E., et XXIII. A.

Table des Matières. Tome XIX., XX. XXI.

Liste des Membres au 1 January 1876.—*From the Society.*

PHILADELPHIA.—Academy of Natural Sciences of Philadelphia.

Proceedings. 1875.—*From the Academy.*

PLYMOUTH.—The Botanical Exchange Club.

Report of the Curator for 1875.

List of Desiderata for 1876.—*From T. R. Archer Briggs.*

SAN FRANCISCO.—California Academy of Sciences.

Proceedings. Vol. V. Pt. 3, 1874.—*From the Academy.*

WASHINGTON.—U. S. Geological Survey of the Territories.

Report. Vol. II. Washington, 1875, 4to., viz. :—The Vertebrata of the Cretaceous Formations of the West. By E. D. Cope.

Vol. IX. Washington, 1876. 4to, viz. :—Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country. By F. B. Meek.

Vol. X. Washington, 1876 4to., viz. :—A Monograph of the Geometrid Moths or Phalænidæ of the United States. By A. S. Packard, Jr., M.D.

Catalogue of Publications. 1874.—*From F. V. Hayden, U.S. Geologist.*

U. S. Geological and Geographical Survey of the Territories.

Annual Report for 1874; viz. :—Survey of Colorado and adjacent Territory. By F. V. Hayden. Washington, 1876. 8vo.—*From the Author (id).*

WATFORD.—Watford Natural History Society and Hertfordshire Field Club.

Transactions. Vol. I. Pts. 1-3. (1875-76).—*From the Society.*

WELWYN.—Botanical Locality Record Club.

Report of the Recorder for 1874.—*From the Club.*

PERIODICALS.

The Farmer. 1875-76.—*Purchased.*

The Garden. 1875-76.—*Purchased.*

The Gardeners' Chronicle. 1875-76.—*Purchased.*

Nature. 1875-76.—*From the Editor.*

The Scottish Naturalist. Nos. XXI.-III. *From Perthshire Society of Natural Science.*

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II.—HERBARIUM.

BALFOUR, ANDREW FRANCIS (Lieut. R.N.). Specimens of nine Plants picked from the summit of Ternati (5000 feet) in the Philippine Isles. Specimen of the "Elang-Elang" plant, from Manilla.

BALFOUR, I. BAYLEY (D.Sc.). A set (with some duplicates) of the Plants collected by him in the Isle of Bourbon. About 325 species.

BENNETT, A. (per J. Sadler). Fine specimens of eleven Rare Plants of S.E. England.

BLOXAM, ANDREW (Rev.). A set of British Roses, and specimens of some of the rarer Rubi, first named by the Donor.

BOSWELL, J. T. (LL.D.) Specimens of *Thymus Chamædrys*, Fr., from Wandsworth, 1853.

BROTHERSTON, ANDREW. Specimens of his principal Botanical Collectings in 1875, including a number of "wool casuals" from the Tweedside.

CROSS, ROBERT. Specimen of *Castilloe elastica*, from banks of the River Rio Chegres, State of Panama. Collected May 1875.

CUNNACK, J. (per J. Sadler). Specimens of *Anthrolobium ebracteatum*, "obtained" from the Scilly Islands.

DUTHIE, J. F. 54 species of European Plants, chiefly Hungarian, from Dr Richter, Lagos.

GROVES, H. and J. (per F. M. Webb). Specimens of 53 rare or critical South England Plants.

M'MIKING, T. Carefully selected specimens of 143 species of Ceylon Ferns, with numerous duplicates, named to Hooker and Baker's "Synopsis," ed. i. Collected by the son of the Donor.

PURCHASED. Fungi Britannici exsiccati. Editio secunda. Cura M. C. Cooke. Fasciculus V.

ROBB, D. C. Specimens of *Naias flexilis*, Rostk., from Clunie Loch, as particularised in current Part of the Transactions.

ROYAL GARDENS, KEW (distributed by direction of the Royal Society). A set of Rodrigues' Island Plants, collected by Dr I. B. Balfour, Botanist and Geologist to the Government Transit of Venus Expedition to that station. About 225 species.

A set of Rodrigues' Island Lichens, from the same source. Determined by Rev. J. M. Crombie. (*Vide* Journal of Botany, Sept. 1876). 55 species.

Also a set of Kerguelen Island Lichens, collected by Rev. Mr Eaton, and determined by Rev. Mr Crombie. 32 species.

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A set of Freshwater Algæ, from Kerguelen Island. Collected by the Rev. Mr Eaton, Naturalist to the Government Transit of Venus Expedition to that station. Determined and mounted by Dr Reinsch. 69 species. Also, a set of Cape of Good Hope Freshwater Algæ, similarly prepared. 46 species.

SADLER, JOHN. Scotch Alpine Plants, principally from Ben Nevis, collected 1876.

The original specimens of *Carex frigida*, All., and *Salix Sadleri*, Syme, discovered in 1874 in Aberdeenshire by the donor; figured and described in Trans. Edin. Bot. Soc. xii. Pt. 2, and reproduced in Jour. of Bot.

SCHIMPER, W. P. (Prof.). "A Collection of nearly all known Species of European Mosses." (*Schimper MS.*) This valuable donation consists of about 930 species and varieties.

SIM, JOHN. Sundry garden escapes, introduced plants, and casuals, from the Perth neighbourhood.

SMITH, WILLIAM, of Whitley, Cheshire (per F. M. Webb). A large quantity of *Callitriche autumnalis* (fresh), from Holford, near Knutsford. Collected 2d Sept. 1876.

WAUCHOPE, Sir JOHN. A parcel of *Cuscuta europæa* (fresh) on Potatoes growing at Edmondstone, near Edinburgh, August 1876.

WEBB, F. M. Sundry Scotch and English Plants, to supply desiderata to the Herbarium and for distribution. About 1200 selected specimens. Collected 1876.

WHITEHEAD, JOHN. Specimens of *Carex ornithopoda*, Willd., from Miller's Dale, Derbyshire. Collected 22d May 1875.

III.—MUSEUM.

ARNOLD'S Models of Fungi, eighth set, consisting of 12 specimens, embracing 5 species, viz., *Agaricus torminosus*, Sch.; *A. deliquescens*, Bull.; *A. longipes*, Bull.; *A. traganus*, Fr.; *Sclerodermа vulgare*, Fr.

CAMPBELL, Dr. Fruit of Gamboge, from Bankok.

CHRISTISON, Sir ROBERT (Bart.) Stones from Loch Earn, covered with *Diatomaceæ;* also, Branch of Juniper (*Juniperus communis*), 14 inches in circumference, and Stem of Dog-rose, 8 inches in circumference, from St Fillans, Perthshire.

DICKSON, Professor ALEXANDER. Specimens of Fungi, including *Dædalia quercina*, *Polyporus fomentarius*, and *P. betulinus*.

DOUGLAS, Dr F. (Kelso). Samples of 12 different kinds of Tea prepared at his plantations in the N.-W. Province of India.

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DUNN, M. Fruit of *Chimonanthus fragrans*, ripened at Dalkeith Palace Gardens; also, Double Leaf of *Stephanotis floribunda*.

KING, Dr. Bundle of Indian Ipecacuan, made up commercially from plants sent out from the Edinburgh Botanic Garden; also, a Bottle of Cinchona Alkaloids, prepared at the Government Plantation, Mungpoo, British Sikkim.

MACHATTIE, T. A. Stem of Tree-fern, Fruit of *Castanospermum australe*, and Seeds of Wild Australian Peach.

MAXWELL, W. H., of Munches. Cone of *Picea religiosa*, ripened at Munches.

MITCHELL, Dr H. Leaves of Coca Plant (*Erythroxylon Coca*), from Trinidad.

ROBB, JAMES. Specimens of Sweet Almonds, ripened in his garden at Meggetland, near Slateford.

ROSS, Mrs (late of Rockville). Ornamental articles of Furniture made from knots of Elm and Plane; also, a specimen of burnt Wheat Straw in a glass case.

SADLER, JOHN. Specimens of Leeks affected with *Uromyces* (*Uredo*) *alliorum*.

TENNANT, Mrs (of The Glen). Flowers of *Rhododendron Nuttallii*, produced in the garden at the Glen.

TREVELYAN, Sir W. C. Section of branch of an old Silver Fir, exhibiting remarkable excentricity in the growth of the layers of wood.

WILSON, Professor. Double Leaf of *Deutzia scabra*.

WILSON, A. STEPHEN. Specimens of Ergot fungus (*Claviceps*).

WATT, JAMES (gardener, 18 Bruntsfield Place). Large fasciated shoot of common Asparagus.

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APPENDIX.

Botanical Society of Edinburgh.

Patron:
HER MOST GRACIOUS MAJESTY THE QUEEN.

LIST OF MEMBERS,

Corrected to November 1876.

HONORARY FELLOWS.

His Royal Highness The PRINCE of WALES, K.G., Hon. F.R.S.E.
His Royal Highness The DUKE of EDINBURGH, K.H., K.T., LL.D.
His Imperial Majesty The EMPEROR of BRAZIL.

BRITISH SUBJECTS (LIMITED TO SIX).

Charles Cardale Babington, M.A., F.R.S., F.L.S., Professor of Botany, Cambridge
George Bentham, F.R.S., 25 Wilton Place, London, S.W.
Rev. Miles Joseph Berkeley, M.A., F.L.S., Sibbertoft, Market Harborough
Charles Darwin, M.A., F.R.S., F.L.S., Down, Beckenham, Kent
George Dickie, M.A., M.D., F.L.S., Professor of Botany in the University of Aberdeen
Joseph Dalton Hooker, M.D., C.B., Pres. R.S., F.L.S., Director of the Royal Gardens, Kew.

FOREIGN (LIMITED TO TWENTY-FIVE).

Jakob Georg Agardh, Stockholm
Henri Baillon, M.D., Professor of Natural History to the Faculty of Medicine, Paris
Anton de Bary, Professor of Botany, Strasburg
Alexander Braun, Member of the Royal Academy of Sciences, Berlin; Professor of Botany and Director of the Royal Botanic Garden, Berlin
Alexander von Bunge, Emeritus Professor of Botany, Dorpat
Joseph Decaisne, Member of the Institute, Professor of Horticulture, Paris
Alphonse de Candolle, D.C.L., Emeritus Professor of Botany, Geneva
Elias Fries, M.D., Professor of Rural Economy, Upsala
Heinrich Robert Goeppert, M.D., Director of the Botanic Garden, and Professor in the University of Breslau
Asa Gray, M.D., Professor of Natural History in Harvard University, Cambridge, Massachusetts
August Heinrich Rudolph Grisebach, Professor of Botany, Gottingen
Oswald Heer, M.D., Professor of Botany, Zurich
Wilhelm Hofmeister, Professor of Botany, Tübingen
Carl Koch, Ph.D. Professor of Botany, Berlin
Charles Martins, Professor of Natural History, and Director of the Botanic Garden, Montpelier
Baron Ferdinand Von Mueller, M.D., Director of the Botanic Garden, Melbourne
Carl Naegeli, Ph.D., Professor of Botany, Director of the Botanic Garden, Munich
Phillippe Parlatore, M.D., Professor and Director of the Museum of Natural History, Florence
Nathan Pringsheim, M.D., Professor of Botany, Berlin
Julius Sachs, Ph.D., Professor of Botany, Wurzburg
Wilhelm Phillipp Schimper, Strasburg
Matthias Jacob Schleiden, Dresden
Dr E. Strasburger, Professor of Botany, Jena
Louis Rene Tulasne, Member of the Institute, and Botanical Assistant in the Museum of Natural History, Paris
Hugh Algernon Weddell, M.D., Poictiers, France

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In the List of Resident Fellows are included some who are not resident in Edinburgh or its vicinity, but who pay Annual Contributions as Resident Fellows, or who have compounded as such.

*Resident Fellows who have compounded for their Annual Subscriptions and Transactions are marked with an asterisk *.*

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*Forsyth, Wm. F.
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Fraser, Rev. James, M.A., The Manse, Colvend, Dalbeattie
*Fraser, Patrick Neill, Canonmills Lodge
Fraser, Thomas R., M.D., F.R.S.E.
*Gair, John, Falkirk
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*Gamble, James Sykes, B.A., Assistant Conservator of Forests, Darjeeling
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Johnstone, W. W., Nursery Manager, Bangholm House
Kay, Rev. Alexander C., Loanhead

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*Leitch, John, M.B. and C.M., Silloth
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*Macadam, Stevenson, Ph.D., F.R.S.E., Portobello
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Wilson, J. T., of Restalrig House.

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Branfoot, J. H., M.D., West Indies
Broome, C.E., M.A., F.L.S, Bath-Easton, Somerset
*Brown, George H. W., Victoria, Vancouver Island
170 *Brown, Isaac, Brantholme, Kendal
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Buckley, Nathaniel, M.D., 196 Yorkshire Street, Rochdale, Lancashire
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ROYAL BOTANIC GARDEN

OF

EDINBURGH.

FOUNDED IN 1670.

REPORT FOR THE YEAR 1875.

THE Regius Keeper presents the following Annual Report on the state of the Garden:—

The ROCK GARDEN is now completed, and is well stocked with Alpine plants. During the spring months a report is kept of the flowering of these and other plants in the Garden, so as to give data for determining the nature of the season. These Reports have been lately utilised by Mr Buchan, the secretary of the Scottish Meteorological Society, in a paper which he read to the Edinburgh Botanical Society.

The Town Council of Edinburgh have taken an interest in the proposed extension of the Garden by the addition of an Arboretum. They have given intimation of a Bill in Parliament on the subject. Their proposal is to have powers to raise by assessment a sum sufficient to purchase 20 acres or more of the Inverleith grounds contiguous to the Botanic Garden on the west. These grounds are the property of the Fettes Trustees, who are willing to enter into terms with the view of having the property added to the Botanic Garden, and then handed over to Government, by whom the Arboretum will be kept up as a valuable

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appendage to the Royal Garden, both as regards the promotion of science and public recreation. The ground to be acquired is in every respect well fitted for these purposes. It would certainly be most injurious to the present Garden if the ground to the west was to be used for buildings.

The Meetings of the Scottish Arboricultural Society are held annually in the Botanic Garden. This Society has petitioned Government in favour of an Arboretum, which would supply means of instruction in the habits, mode of culture, and growth of trees, and their value in an economical and picturesque point of view. The information thus acquired would be important, not merely to foresters in Britain, but also to the young men who are now sent out to India and the colonies. I feel encouraged in this matter by the warm interest shown by the Lord Provost, the Duke of Buccleuch, the Lord Justice-General, Sir Robert Christison, Sir James Elphinstone, Dr Lyon Playfair, Mr Adam, M.P., Mr Duncan M'Laren and Mr James Cowan, the Members of Parliament for Edinburgh, and others.

The Botanical Society of Edinburgh also meets during summer in the Garden. This Society also has petitioned in favour of the addition to the Garden, and its President, Sir Robert Christison, Bart., has given an address on the subject, which has been published and transmitted to Government.

The specimens added to the Garden, the Museum, and the Herbarium, are given under separate heads in the Report. A list of works contributed to the Library is also given.

The Visitors during the year 1875 have amounted to 87,574, being 6365 more than last year.

The Regius Keeper has again to represent to the Office of Works that the present Class Room in the Garden is far too small for the number of pupils, and great difficulty has been experienced, for the last two years especially, in carrying on the class work. Although every available means has been used to afford sitting-room to those attending the classes, there are still a large number who are compelled to stand during lectures. The pupils last session petitioned

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the Government on the subject, and stated fully the hardships to which they were subjected. I cannot too strongly urge the absolute necessity for something being done in the way of giving enlarged accommodation. There is ample space for building. The present room might with great advantage be converted into one for practical work, while a new Lecture Room could be built in connection with it towards the west. The present practical room is too small for the number of pupils, and the conversion of the present Class Room into one for practical experimental study would be a great boon. The sooner steps are taken for remedying the evil complained of the better will it be for the Garden as a School of Instruction in Botany.

Another subject which I have also brought under the notice of Government, is the necessity for some addition to the allowance for the Garden, so as to enable the Regius Keeper to have a curator of the Herbarium and Library. These require daily attendance, and at present their usefulness is materially injured by the want of some one in constant charge. I have to mention this as a great hardship, and a decided hindrance to the usefulness of the Institution.

The arrangements for instruction in the Garden are as follows:—

1. LECTURES are given every MONDAY, TUESDAY, WEDNESDAY, THURSDAY, and FRIDAY, at 8 A.M., from the beginning of May till the end of July.
2. EXAMINATIONS are conducted on WEDNESDAYS.
3. MONTHLY COMPETITIVE EXAMINATIONS FOR HONOURS are also conducted.
4. Besides the Lectures, DEMONSTRATIONS are given on the Natural Orders, on the Preparations and Models in the Museum, and on the Plants in the Hothouses. The Demonstrations in the Garden are given on FRIDAYS, from 9 to 10 A.M.
5. CLASS FOR VEGETABLE HISTOLOGY AND PRACTICAL BOTANY meets on MONDAYS, TUESDAYS, WEDNESDAYS, and THURSDAYS, at 9 A.M.
6. SATURDAYS are occupied with Excursions and Demonstrations in the Fields.
7. The MUSEUM and HERBARIUM ROOM at the Garden are open daily for the examination of specimens.
8. PRIZES are given by the Regius Keeper for Competitive Examinations, Herbaria, Essays, Dissections, Models, and Microscopical Preparations.

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The Lectures in the Garden, in the summer of 1875, were attended by 343 students, including Students of Medicine, Science, Pharmacy, as well as general students; and the Practical Class for Microscopic Examination of Plants numbered 65, thus making in all 408. The rooms for practical instruction were open during the whole day from May to July, and pupils had an opportunity of studying in the Garden from 6 A.M. till 6 P.M. During the summer of 1875 there was also a special Class, attended by 42 Veterinary students. Besides lectures, demonstrations were given by the Regius Keeper in the Conservatories and Hothouses. In carrying on the practical work of the Class, more especially demonstrations in the Microscopical room and in the fields, the Regius Keeper employs several Assistants, for whom there is no provision in the Estimates.

Number of Fresh Specimens of Plants Used.

Specimens given to Students at Class Room Door, . .	52,434
„ used at Competitive Examinations, . . .	6,600
„ for Class Demonstrations, ...	7,500
„ Students' Private Examinations, . . .	3,200
„ for Lecture Illustrations, ...	3,800
„ used in Histology Class Room, . . .	1,920
	75,454
Pot Plants placed on Class Room Table, . . .	2,250
Total, . .	77,704

Practical instruction was also given by means of Excursions, and numerous rare native plants were thus added to the Garden collection. The extent of these Excursions may be seen from the following statement:—

1. Roslin and Polton. 2. Burntisland and Aberdour. 3. Longniddry and Prestonpans. 4. Currie and Colinton. 5. Balerno and the Pentland Hills. 6. Perth. 7. Broughty Ferry and Barry. 8. Leslie and Lomond Hills. 9. Killin and the Breadalbane Mountains.

Number of Species of Plants collected during the Excursions:—Phanerogamous Plants, 530; Ferns and their Allies, 38; other Cryptogams, 60. Total, 628.

Number of miles travelled by railway, steamboat, and

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walking, 600. The number of Students who attended the Excursions was 240; and the number at each Excursion varied from 32 to 135.

The Government School of Design has been supplied weekly with plants for the use of the pupils.

Some of the gardeners attend the course of lectures, and assist in the distribution of plants.

To show the interest taken in the work at the Garden, the Regius Keeper calls attention to the following Prizes, which have been offered through the Council of the Botanical Society:—

I. The Botanical Society Prize.

The Botanical Society offers a Prize of Ten Guineas for the best and improved Essay on the Reproduction of Lycopodiaceæ, to be competed for by Students who have attended the Botanical Class at the Royal Botanic Garden, Edinburgh, during at least one of the three years preceding the award, and have gained honours in the Class Examinations.

The author is expected to give results of practical observations and experiments made by himself on the subject, illustrated by microscopical specimens.

The Essays and Specimens to be given in on or before 1st May 1876, with a sealed note containing the author's name, and a motto outside.

Facilities will be given for carrying on observations and experiments at the Royal Botanic Garden, Edinburgh.

II. The Jenner Prize.

A Prize of Ten Guineas is offered, through the Council of the Botanical Society, by Charles Jenner, Esq., for the best and approved Essay on the Structure and Reproduction of the Frondose and Foliaceous Jungermanniaceæ. This Prize is subject to all the conditions specified in the case of No. 1.

The Regius Keeper will be glad to receive donations of plants and seeds, as well as specimens for the Herbarium and Museum, from correspondents abroad. He trusts that his pupils, who are scattered over various parts of the world, will continne to aid him by their contributions.

New trees and shrubs from British and Continental nurserymen, suited for the Arboretum, will be specially acceptable; and exchanges will be made. All donations will be duly acknowledged and labelled in the collection.

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The following is a list of the Gardens to which Plants and Seeds have been forwarded during the year 1875 :—

Royal Garden, Kew.
Botanic Garden, Hull.
Botanic Garden, Liverpool.
Botanic Garden, Oxford.
Botanic Garden, Glasgow.
Botanic Garden, Glasnevin, Dublin.
Botanic Garden, Trinity College, Dublin.
Botanic Garden, Belfast.
Botanic Garden, Calcutta.
Botanic Garden, Melbourne.
Botanic Garden, Harvard University, U.S.
Messrs Cunningham & Fraser, Comely Bank Nursery.
Messrs J. Dickson & Son, Inverleith Nursery.
The Lawson Nursery and Seed Company.
P. S. Robertson, Trinity Nursery.
John Anderson, Perth Nurseries, Perth.
Messrs Barr & Sugden, 12 King Street, Covent Garden, London.
Messrs E. G. Henderson, Nurserymen, St John's Wood, London.
Messrs Low & Company, Upper Clapton Nursery, London.
Messrs Veitch & Son, Royal Exotic Nursery, Chelsea, London.
T. S. Ware, Hale Farm Nursery, Tottingham.
Messrs Jackson & Son, Nurserymen, Kingston, Surrey.
Robert Parker, Tooting Nursery, Surrey.
J. Backhouse & Son, Nurserymen, York.
Isaac Anderson-Henry, Hay Lodge, Trinity.
Mrs Dunsmure, Glenbruich, Callander.
Miss Hope, Wardie Lodge, Trinity.
Charles Jenner, Easter Duddingston Lodge.
Max Leichtlin, Baden-Baden.
George Maw, Benthall Hall, Broseley.
George Potts, Fettes Mount, Lasswade.
Robert Buist, Nurseryman, Philadelphia.
Messrs Dickson & Company, Leith Walk Nursery.
Lady Ord, Kilmory, Argyleshire.
Giles Munby, The Holt, Farnham, Surrey.
William Barron, Nurseryman, Elvaston, Derby.
William Gorrie, Rait Lodge, Trinity.
Messrs Drummond Brothers, Nurserymen, Edinburgh.
Messrs Ballantyne, Nurserymen, Dalkeith.

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I. DONATIONS OF PLANTS

TO THE ROYAL BOTANIC GARDEN, EDINBURGH,

DURING THE YEAR 1875.

BACKHOUSE and SON, Nurserymen, York.—18 rare species of Alpine Plants.

BALFOUR, Dr I. BAYLEY.—22 species of Plants from the Island of Rodrigues; roots of *Zingiber officinale*.

BARR and SUGDEN, Nurserymen, Covent Garden, London.—12 species of Bulbous Plants, &c.

BELFAST BOTANIC GARDEN.—12 species of Stove and Greenhouse Plants; also *Cheiranthus alpinus*, and Double White Rocket.

BOYD, W. B., Ormiston, Kelso.—4 species of Alpine Plants.

BROTHERSTON, ANDREW, Kelso.—*Ranunculus sp.?* 7 species of Willows, and *Cuscuta Epilinum*.

BUIST, R., Nurseryman, Philadelphia, U.S.—20 species of Rare Plants, and 50 Roots *Dionæa Muscipula*.

CAIRD, FRANCIS M.—Plants of *Drosera Anglica*.

CRAIG, JOHN, Ploughland, Strathaven, Lanarkshire.—Plants of *Botrychium Lunaria*.

CREW, The Rev. H., The Rectory, Drayton, Beauchamp.—Roots of *Crocus Damascenus*.

DICKSONS and Co., Nurserymen, Edinburgh.—13 named varieties of Late Flowering Phloxes.

DICKSON, Professor ALEXANDER, Glasgow.—*Salix*, species from Tyndrum.

DOUGLAS, A. S., Crawford Bank, Lasswade.—*Helichrysum sp.?*

DRUMMOND BROTHERS, Nurserymen, Edinburgh.—*Curculigo recurvata*.

DUBLIN BOTANIC GARDEN, Glasnevin.—50 species and varieties of Stove, Greenhouse, and Hardy Plants.

DUNSMURE, Mrs, Glenbruich, Callander.—Roots of *Tropæolum speciosum*.

GORRIE, WM., Rait Lodge, Trinity.—Plants of *Aciphylla squarrosa*, *Plagianthus betulinus*, &c.; also Black Italian Poplar and a Lime Tree, with Mistleto growing on each; *Primula scotica*, and *Scilla verna* from Wick.

HENDERSON, Messrs E. G., Nurserymen, St John's Wood, London.—21 species of Rare Alpine and Herbaceous Plants.

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HENRY, I. ANDERSON, Hay Lodge, Trinity.—7 species of Herbaceous Plants, including *Delphinium Cashmerianum*, and *Androsace sarmentosa*.

HOPE, Miss, Wardie Lodge.—*Helleborus angustifolius*.

HORNE, JOHN, Botanic Garden, Mauritius.—28 species of Stove Plants.

HULL BOTANIC GARDEN.—20 species of Alpine and Herbaceous Plants.

JACKSON, Messrs T. and SON, Nurserymen, Kingston, Surrey.—12 species of Stove and Greenhouse Plants.

JAMESON, Dr WM., Botanic Garden, Saharunpore.—Roots of *Gloriosa superba*, *Hedychium coccineum*, and *Nardostachys Jatamansi*.

JENNER, CHARLES, Easter Duddingston Lodge.—Roots of *Scilla Siberica striata*; 7 Alpine Plants, including *Primula Parryi*.

KENNEDY, JOHN, Colzean Cottage, Summerlee, Coatbridge.—12 varieties of Spotted Mimulus.

KEW, THE ROYAL GARDENS.—42 species of Rare Stove, Greenhouse, Hardy Plants.

LAWSON NURSERY AND SEED COMPANY.—*Taxus adpressa variegata*, *Cupressus Lawsoniana filifolia*, and *Juniperus Lawsoniana*.

LEICHTLIN, MAX, Baden-Baden.—12 species of Rare Herbaceous and Bulbous Plants.

LIVERPOOL BOTANIC GARDEN.—20 species of Stove, Greenhouse, and Hardy Plants.

MAW, GEORGE, Benthall Hall, Broseley.—10 species of Rare Bulbous Plants, chiefly from Corsica; 7 species of Primula from Switzerland; 6 Roots of *Iris Tingitana*; 6 species of Bulbous Plants from Portugal; 20 species of Rare Alpine Plants.

MONCRIEFFE, Sir THOMAS, Bart., Moncrieffe House, Perthshire.—A large Plant of *Cycas revoluta*.

MUNBY, GILES, The Hall, Farnham, Surrey.—12 species of Oxalis.

ORD, Lady, Kilmory.—*Hypericum Mysorense*.

OXFORD BOTANIC GARDEN.—16 species of Hardy Alpine Plants and Ferns.

PARKER, ROBERT, Nurseryman, Tooting, Surrey.—24 species of Stove, Greenhouse, and Alpine Plants.

PATERSON, Dr, Bridge of Allan.—Large Plant of *Stangeria paradoxa*.

POTTS, GEORGE, Fettes Mount, Lasswade.—12 species of Saxifrages and Sempervivum; also a Hardy Yellow Gladiolus.

ROBB, D. C., Blairgowrie.—Plants of *Naias flexilis*.

ROBERTSON, P. S., Trinity Nursery.—Specimen of *Todea superba*, from New Zealand, with a Double Crown.

SADLER, JOHN, Edinburgh.—15 speciesof British Willows from Ye holm.

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TAYLOR, J. R., 63 Frederick Street, Edinburgh.—Case containing 8 species of Plants from Bermuda.

VAN HOUTTE, LEWIS, Nurseryman, Ghent.—4 species of *Bertolonia.*

VEITCH and SON, King's Road, Chelsea, London.—7 species of *Nepenthes*, also fine Plants of *Abies firma*, and *A. Veitchii.*

WARE, T. S., Hale Farm Nursery, Tottingham, London.—30 species of Hardy Alpine and Herbaceous Plants.

WATERER, Messrs, Nurserymen, Knaphill, Surrey.—3 fine Plants of *Cupressus Lawsoniana erecta viridis.*

WHITEHEAD, J., 33 Brunswick Street, Duckinfield.—*Carex ornithopoda*, from Millar's Dale, Derbyshire.

WILSON, Prof. JOHN, Eskgrove.—Plant of *Saxifraga Tagetta.*

WISHART, Miss, 14 St Vincent Street, Edinburgh.—3 Cyclamen Roots from Palestine.

II. DONATIONS OF SEEDS.

BALFOUR, Lieut. A. F., R.N., Her Majesty's Ship "Challenger."—63 species of Australian Seeds.

BALFOUR, Dr I. B.—Fern Spores from Bourbon, 20 species; also 9 species of Palm Seeds; 81 species of Seeds from Mauritius and Rodrigues.

BELL, Miss, 64 Inverleith Row, Edinburgh.—Seeds from Caffreland.

BIGGS, Lieut. H., R.N.—9 species of Mexican Seeds.

CALCUTTA BOTANIC GARDEN.—42 species of Hill Seeds, mostly rare Alpines.

CHELSEA BOTANIC GARDEN.—24 species of Herbaceous Seeds.

CONSTABLE, Rev. J., Principal of the Agricultural College, Cirencester.—Seeds of *Abies Williamsoni* from California.

CRAIG, Dr WILLIAM, Edinburgh.—Seeds of Jaborandi.

DUBLIN BOTANIC GARDEN, Glasnevin.—17 species of Herbaceous Seeds.

DUTHIE, JOHN F.—Seeds of *Hyoseris lucida, var.*, from the island of Goza; *Celsia, sp.?*

ELWES, The Rev. H. T., Miserden House, Cirencester.—13 species of Seeds, chiefly from the Alpine parts of Sikkim.

FRASER, Mrs C., Sea Bank, Inverness.—Seeds of a species of *Asclepias.*

GORRIE, WILLIAM, Rait Lodge, Trinity.—Seeds of *Quercus Ilex*, and *Q. Lucombiana*; Rice Seeds from Canada.

GROUMEYER, R., Catherine Bank, Newhaven.—Seeds of *Quercus Ballota* from Spain.

HANBURY, DANIEL, London.—Seeds of *Ferula alliacea*, Boiss.

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HENRY, I. ANDERSON, Hay Lodge, Trinity.—Seeds of *Anchusa capensis*, and a species of *Iberis* from Nevada; 12 species of Fern Spores from New Zealand.

HUGHES, G. J.—10 species of Californian Conifers.

HUTCHISON, ROBERT, Carlowrie.—3 species of Seeds from Canada.

INDIA MUSEUM, London.—Seeds of *Cedrus Deodara*.

KEW, THE ROYAL GARDENS.—Seeds of *Rheum nobile;* 28 species of Herbaceous Seeds.

KING, Dr, Botanic Garden, Culcutta.—Seeds of *Acer oblongum*, *Rhodomyrtus tomentosa*, and *Rhododendron arboreum*, 32 species of other Seeds.

LAURIE, ALEX., Merchant, Calcutta. — 4 species of Coniferous Seeds.

LEFEVRE, GEORGE H.—Cotton Seeds from New South Wales.

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